the TRIPLE HELIX 10th international conference 2012

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CONFERENCE PROCEEDINGS
EMERGING TRIPLE HELIX MODELS FOR DEVELOPING COUNTRIES

the TRIPLE HELIX 10th international conference 2012

EMERGING TRIPLE HELIX MODELS FOR DEVELOPING COUNTRIES

Grand Royal Panghegar, Bandung, West Java, Indonesia

CONFERENCE PROCEEDINGS

FROM CONCEPTUALIZATION TO IMPLEMENTATION

08-10 august 2012

Penerbit ITB

Organized by:

RISTEK

TRIPLEHELIX association UNIVERSITY INDUSTRY GOVERNMENT

Welcome to the Triple Helix 10th International Conference, and welcome to Bandung.

Selamat Datang di Konferensi Internasional ke-10 Double Helix dan selamat datang ke Bandung.

The theme of the Conference is *Emerging Triple Helix Models for Developing Countries: From Conceptualization to Implementation.* The sub-themes chosen for the Conference reflect global topics as well as regional issues and include:

- Strengthening National Innovation Policies in Developing Countries
- Building Infrastructure
- Success stories in Enhancing the Relevance if the Triple Helix Model.

The Conference had attracted close to 300 submissions, and the Scientific Committee had the onerous task of selecting a subset for presentation. The rigorous selection process has ensured a very high quality event. To meet the stringent standards set by the Scientific Committee, less than 53% of submissions will be presented.

The Conference brings together policy makers, leading academic thinkers, influential government representatives, and industry decision makers, reflecting the nexus of the Triple Helix, to discuss and debate topics of current importance aimed at identifying present trends and future directions. Lessons learnt from TH-2012 will undoubtedly find application in international settings and, in particular, aid developing countries to benefit from government, industry, and academic interactions, to achieve sustainable economic growth and to develop a culture of continuous innovation.

We have an engaging technical programme with a number of keynote presentations by some of the world's leading experts, and a large number of excellent presentations in the technical parallel sessions. Each day is devoted to a specific sub-theme, and the plenary and parallel sessions reflect this sub-theme.

We are fortunate that a number of senior Government Ministers from Indonesia and the ASEAN countries are attending the Conference, and we are particularly delighted that **Professor Dr Ir H Gusti Muhammad Hatta MS,** The State Minister for Research and Technology, Republic of Indonesia, and **Professor. Dr Ir KH Mohammad Nuh DEA,** The State Minister for Education and Culture, Republic of Indonesia, will make the opening speeches at the Conference. We look forward to their presentations and to receiving the benefit of their wisdom and experience.

Mr H Ahmad Heryawan, the Governor of West Java Province, has been most supportive of the event, and it was his guidance that led the Conference Organising Committee to include aspects of the impact of the Triple Helix on community engagement and on arts, design and culture.

We appreciate the inclusion of the Conference as the concluding event of the National Awakening Day Celebration (Hakteknas-17) in Bandung. This is indeed a fitting tribute to the importance, relevance, and alignment of the Conference proceedings to the themes of Hakteknas-17, that of Techno-entrepreneurship, Innovation, and Technology bridges.

We are grateful for the support provided by RISTEK (the Indonesian Ministry of Research and Technology), the Indonesian Ministry of Education, and ITB (Bandung Institute of Technology), without which the Conference would simply not have happened.

Several people have worked long and hard to organise this event. I would specially like to mention Dr Dwi Larso and Dr Eko Prasetio of ITB, and Nada Marsudi and Amir Manurung of RISTEK and Sheila Forbes of the University of Strathclyde for their selfless efforts that have contributed to the success of this Conference.

Bandung is a gem of culture, design, and arts in Indonesia. We hope that in addition to attending the Conference, you will take the opportunity to visit some of the city and sample its cultural, artistic and culinary delights. Indonesia itself offers a wealth of facilities for vacation, ranging from fabulous beaches, exotic but safe volcanic sites, stunning scenery, historic locations, and fabulous arts and craft.

We look forward to seeing you, and wish you an enjoyable conference and memorable stay in Indonesia.

Tariq S Durrani

Chair - International Committee

Triple Helix 10th International Conference

Bandung, Indonesia

10-12 August 2012

Foreword by the Ministry of Research and Technology, The Republic of Indonesia

“The Triple Helix 10th International Conference” (*abbr*. TH 2012) has been an exemplary commitment of the Government of Indonesia (GOI) to work together with the largest extent of national and international entities, as well as the communities, to generate and harness of the awareness about the great potentials of science and technology innovation (STI) for bringing improved welfare for the people of developing countries.

As articulated by the theme of TH 2012, "Emerging Triple Helix Models for Developing Countries: From Conceptualisation to Implementation", we wish to exemplify the discussion of the importance of STI as an integrated strategy in the pursuit of enhancing competitiveness and equalising footings for the developing countries to interact with the more developed economies.

The blending of the wide organisers of TH 2012 is very charmingly unique, our collaboration suggests a selfless quest. We come from the Ministry of Research and Technology – Republic of Indonesia (Ristek); the Ministry of Education and Culture – Republic of Indonesia; the Provincial Government of West Java – Republic of Indonesia; the prestigious university, Institut Teknologi Bandung (ITB); the Secretariat of Association of Southeast Asian Nations (ASEAN); and the multinational body of Triple Helix Association (THA).

Together, we work in arms-length belief to organise TH 2012 as an event that gives dignified stage for the academicians, business people, government institutions, and the general public, to speak about their experiences and thus assertion to intentionally collaborate among another in joint platforms that transform their own nations, and hence the world. We all intent to see that everybody has the engaging access to assign or initiate direct contributions in bringing better future for themselves and their families.

We therefore recognise TH 2012 as a comprehensively outreaching programme for people to unite to innovate.

The uniting message has been profoundly strengthened by the delivering of TH 2012 as a part of programme activities to Indonesia’s celebrating the 17th National Technology Awakening Day (*abbr*. “*Hakteknas*”). We proudly present widest opportunities for all TH 2012 participants to attending Hakteknas’ events that jointly themed together as “*Bandung, the seas of science and technology*”.

We know Bandung city is very fitting to greet and welcome international audience to convene in an event with subject of innovation. In her most relevant legacy, Bandung was the city that witnessed Indonesia’s launching the nation’s first aircraft, CN-250, in Bandung, in 10 August 1995. That date, 10 August, was adopted as the day when nation is celebrating the awakening of technology development.

Meanwhile Bandung also pertains with deep inclination to the chronicle of the uniting spirit of developing countries. In 1955, the city hosting the first large-scale Asian–African or Afro–Asian Conference, that represented the amalgamation spirit of more than a half population of the world: the people that live in developing countries.

Now, through TH 2012, we offer advancement in combining the two great moments in history. Through TH 2012, we target to motivate developing countries, including Indonesia, to accelerate the catching up progress using STI principles. That through the collective effort by the “Triple Helix” groups of the academics, business, government -- strengthened by the community -- we may see in our lifetimes STI will help to narrow the gap in the levels of welfare improvement among all nations in the world.

By all these inspirations, we highly thank all presenters, participants, sponsors, and members of the organising committees of TH 2012. Please bring back the memory of the beautiful country that Indonesians inherit by God's grace. More importantly, we sincerely wish that all the ideas reap here, will be very fruitful in making the world a better place to be.

Enjoy your time in Indonesia.

Prof. dr. Amin Soebandrio Ph.D., SpMK

Deputy of S&T Network to the State Minister for Research and Technology (ad interim)

The Ministry of Research and Technology

The Republic of Indonesia

The 10th Triple Helix International Conference 2012, Bandung, Indonesia

Technical Programme - DAY ONE - (August, 8th)

Time			Event	Role	Name
08.00	-	08.27	**Registration**		
08.27	-	08.30	**MC Opening**		
08.30	-	08.40	**Traditional West Java Welcoming Dance**		
08.40	-	09.00	Opening	ITB Rector	Prof. Akhmaloka
09.00	-	09.20	Speech	President of THA	Prof Etzkowitz
09.20	-	09.40	Speech	Research & Technology Minister	Prof. Gusti M. Hatta
09.40	-	09.45		Official Opening with Kendang	
09.45	-	10.25	Keynote	Stanford University	Prof. Etzkowitz
10.30	-	11.00	**Coffee break**		
11.00 - 12.45			Panel Session 1 (Johann Lohn, Marko Ahtisaari*, Xudong Gao, Dr. Nobrega) on Academia, Business and Government Interaction for Innovation Moderator: Prof. Togar M. Simatupang		
12.45	-	14.00	**Break/Lunch**		
14.00	-	15.30	**PARALLEL SESSION 1A**	**Satelite Event: Agriculture beyond Food (AbF) – Paseban Deco**	
15.30	-	16.00	**Coffee break**		
16.00	-	17.30	***PARALLEL SESSION 1B***		
17.50	-	18.30	Refreshment (Tajil) and Magrib prayer		
18.30	-	18.33	**MC Opening**		
18.33	-	18.40	Welcoming Performance		
18.40	-	19.10	Statements	Deputi Menristek	Prof. Amin Soebandrio
				SBM ITB Dean	Prof. Sudarso K. W
				Director of DAAD	Dr. Jansen
				International Chair	Prof. Tariq Durrani
19.10	-	19.40	**Buffet**		
19.40	-	19.50	Jaipong (West Java Traditional Dance Performance)		
19.50	-	20.00	Closing remarks		

The 10th Triple Helix International Conference 2012, Bandung, Indonesia					
Technical Programme - DAY TWO - (August, 9th)					
Time			**Event/Role**		**Name**
			Event	**Role**	
08.00	-	08.55	**Registration**		
08.55	-	09.00	**MC Opening**		
09.00	-	09.45	Featured Speech 1	PT BakrieTelecom	Anindya Bakrie
09.45	-	10.30	Featured Speech 2	CEO Edwar Technology (C-TECH)	Dr. Warsito Purno Taruno
10.30	-	11.00	**Coffee break**		
11.00 - 12.30			Panel Session 2 (Dasep Ahmadi, Caroline Paunov, Loet Leydesdorff) on Academia, Business and Government Interaction for Entrepreneurship		
13.30	-	15.00	***PARALLEL SESSION 2A***		***Satellite Event: READY SEMINAR- Amartapura C***
15.00	-	15.30	**Coffee break**		
15.30	-	16.30	***PARALLEL SESSION 2B***		***Satellite Event: READY WORKSHOP- Amartapura D***
17.00		17.30	***BUS TIME to GEDUNG SATE***		
17.50	-	18.30	Refreshment (Tajil) and Magrib prayer		
18.30	-	18.33	**MC Opening**		
18.33	-	19.00	Statements	Vice Rector	Dr. Wawan Gunawan
				West Java Governor	Achmad Heryawan
				Ministers	Gusti M. Hatta, ASEAN Ministers
19.00	-	19.30	**Dinner and Cultural Event**		
19.30	-	19.45	Best Student Paper Award		
19.45	-	20.00	Closing remarks	Co Chair THC X 2012	Dwi Larso, PhD

The 10th Triple Helix International Conference 2012, Bandung, Indonesia					
Technical Programme - DAY THREE - (August, 10th)					
Time			**Event/Role**		**Name**
			Event	**Role**	
08.00	-	08.25	**Registration**		
08.25	-	08.30	**MC Opening**		
08.30	-	10.00	ASEAN Ministerial Panel		
10.00	-	10.15	**Coffee break**		
10.15	-	11.15	Triple Helix Association General Assembly and Closing		
11.15	-	11.20	**Closing Speech 1**	**Vice Rector ITB**	**Dwi Larso, Ph.D**
11.20	-	11.25	**Closing Speech 2**	**Menristek**	**Prof. Dr. Ir. H. Gusti M. Hatta**
11.25	-	11.30	**Closing Speech 3**	**President of THA**	**Prof. Henry Etzkowitz**
11.30	-	13.30	**Jumah Prayer or Lunch**		
13.30	-	16.00	***Visit to Ritech Expo (Sabuga) - optional***		

FEATURED SPEAKERS

Prof. Akhmaloka, Ph. D.
Rector of Institut Teknologi Bandung

Prof. Henry Etzkowitz
President of Triple Helix Association

Prof. Dr. Ir. H. Gusti Muhammad Hatta, MS
The State Minister for Research and Technology, Republic of Indonesia

Prof. Dr. Ir. KH. Mohammad Nuh, DEA
The State Minister for Education and Culture, Republic of Indonesia

Prof. Dr. Sudarso Kaderi Wiryono
Dean of School of Business and Management,
Bandung Institute of Technology

Prof. Amin Soebandrio
Deputy of Ministry for Research and
Technology, Republic of Indonesia

Dr. Irene Jansen
Director of DAAD

Prof. Tariq Durrani
International Chair of Triple Helix Association

Anindya Bakrie
CEO PT Bakrie Telecom

The 10th Triple Helix International Conference 2012, Bandung, Indonesia
PARALLEL SESSION - Day 1 - 8 AUG 2012

Session 1A	Parallel 1A1	Parallel 1A2	Parallel 1A3	Parallel 1A4	Parallel 1A5	Parallel 1A6	Parallel 1A7	Parallel 1B8
Session Title	A. Triple Helix in Art, Design, and Culture	B. Triple Helix Collaboration for Small and Medium Enterprises	C. Implementation of Triple Helix Model in Entrepreneurship	D. Higher Education Role in Triple Helix	E. Triple Helix Model for Developing Countries	F. Triple Helix Model for Innovation and Commercialization	F. Triple Helix Model for Innovation and Commercialization	J. Building Infrastructure
Room	Ayodya A	Ayodya B	Ayodya C	Ayodya D	Madhukara A	Madhukara B	Suralaya	Suralaya
Session Chair	Deddy P. Koesrindartoto, Ph.D	Prof.Henry Etzkowitz	Jose Manoel Carvalho de Mello	Dr.Isrochmani Murtaqi, M.Acc	Yos Sunitiyoso, ST., M Eng., Ph.D	Dr. Ir. Budhi Arta Surya, MSc	Prof. Tariq S. Durrani	Wawan Dhewanto, Ph.D
14.00 - 15.30	43 (Dealing with Cultural Issues in The Triple Helix Model Implementation: A Comparison among Government, University and Business Culture)- **Victoria E. Erosa**, University of Applied Sciences (Hochshule),	61 (Helix networks: A case study of SME-based industries in Thailand)- **Karantarat Nakwa**, Patarapong Intarakumnerd,	214 (Identification and prioritization of factors affecting entrepreneurship development in online stores)- **Fransisca Budyanto Widjaja**, Catharina Tan Lian Soei	20 (Production-based Education (PBE): The Future Perspective of Education on Manufacturing Excellence)- **Ismet P. Ilyas and Transmissia Semiawan**	254 (Explaining different modes of interaction university-enterprise-government to enhance innovations: case studies of Brazilian firms)- Edi Madalena Fracasso, Paulo Antônio Zawislak, **Lázaro Sumba and André Alves**	17 (Where is Synergy Indicated in the Norwegian Innovation System? Triple-Helix Relations among Technology, Organization, and Geography)- **Loet Leydesdorff**, Øivind Strand	238 (Strengthening National Innovation Policies in Developing Countries: New approaches for Analysing National Innovation Systems in Emerging and Developing Countries – ANIS)-**Uwe Seidel**, Lysann Mueller, Dr. Gerd Meier Zu Koecker	183 (Analyzing Government Policies towards Renewable Energy. Case study : Biodiesel Industries in Indonesia)-**Shimaditya Nuraeni**,Dhanan Sarwo Utomo
	52 (Wooden heritage restoration program illustrating the Triple Helix interaction in Tomsk region)- **Maria Afanasyeva**	133 (The Small and Medium Business Cluster Growth Model)- **Sri Herliana**, Qorri Aina	2 (Research-Based Entrepreneurship)- Markus Santoso, **Leslie Benares**	60 (Entrepreneurial University in Russia: From Idea to Reality)- Evgeniy Perevodchikov, Alexandr Uvarov	131 (Triple Helix Collaboration to Develop Economic Corridors as Knowledge Hub in Indonesia)- **Lenny Martini**, Yudo Anggoro, Jann Hidajat Tjakraatmadja, Adita Pritasari, Libertha Hutapea	26 (Public-private partnerships for the management of demand driven collaborative research and development innovation systems)- Bill Boland, **Sara McPheeKnowless**, Cami Ryan,Peter Philips	72 (Triple Helix Research Collaboration In Developing Technological Innovation: The Case of Computer Based Interlocking)- **Erry Ricardo**, Marhaindro Waluyo	291 (Monitoring System on Nine Primary Commodities' Price)-Iin Mu'minah, Sofyan Sjaf, Wahyu W. Pamungkas, Wahdat Kurdi
	220 (Promoting Value Co-creation Process within Garut Leather Jackets Industrial Cluster using Agent-Based Modeling and Simulation Methodology)- **Dhanan Sarwo Utomo**, Kiki Sarah Amelia, Santi Damayanti, Yuliati Komar	147 (The Development of Islamic Financing Scheme for SMEs in a Developing Country: The Indonesian Case)- **Aulia Nurul Huda**	36 (Entrepreneurial capabilities in a Brazilian university: the case of the federal university of Rio de Janeiro)- Thiago Renault, **Jose Manoel Carvalho de Mello**	62 (Knowledge Flow through the Academia- Industry Collaboration or Supply Chain Linkage? Case Study of the Automotive Supporting Industries in the Jababeka Cluster, Indonesia)- Farah Purwaningrum, Hansdieter Evers, **Yaniasih**	296 (University, Industry, and Government partnership: its present and future challenges in Indonesia) - **Bagyo Y. Moeliodihardjo, Biemo W. Soemardi, Satryo S. Brodjonegoro**, Sachi Hatakenaka	30 (Hierarchic model of creating policy for developing innovative technologies supporting sustainable economic growth)- **Adam Mazurkiewicz**,Beata Poteralska	97 (Collaborative Networks and sustainable business: a case study in the Brazilian System of Innovation)- Leonardo Garnica, Pollyana Varrichio, Adriano Jorge,**Daniela Diogenes**	249 (Contributions from Porto Digital to the Habitat's Socio-Economic Development) - Joana Sampaio, Cidinha Gouveia, Helena Albuquerque,Francisco Albuquerque Neto
	150 (Socio-Economic Factors Affecting to Implement of Business Management and Primatani Technology and Net Income of Banana Agribusiness)- **Asep Darmansyah**, Henny Purwaningsih and Ida Marina	3 (Qualitative Approaches as Formative Evaluations: The Missing Link in the Public Support to SMEs)- **Arturo Vega**, Mike Chiasson, David Brown	48 (From "Family based" to "Industrial based" production Combining the triple Helix model and "Empowerment" in a LED approach.)- **Bartjan Pennink**	236 (Increasing faculty research productivity via a Triple-Helix modeled university outreach project: empirical evidence from Thailand.)- **Suteera Chanthes**	299 (Bandung as Service City in Indonesia: Role of Academician, Business, and Community)- **Achmad Ghazali**, Lenny Martini	66 (Building a Triple Helix corporation: organizational innovation for industry-university engagement in a catch-up region)- **Manuel Fernandez-Esquinas**, Manuel Pérez-Yruela and Sandro Giachi	101 (Triangulation of the triple helix: a conceptual framework for regional competitiveness focused on innovation and local entrepreneurship.)- **Luís Farinha**, João Ferreira	75 (Learning Style Analysis to Improve Learning Method Effectiveness for Management of Telecommunication and Informatics Business Study Programme in Institut Manajemen Telkom)-**Ratri Wahyuningtyas**
LO	Muslim Pribadi - 08122468428	Arien Arianti - 087822454244	Fransisca - 081910105679	Adita Pritasari - 0817401315	Enny Nur - 08562367774	Deru R - 081573406623	A.R Sofyandi - 081349206632	Nur HattaKrisna - 0811919838
15.30 - 16.00	Coffee break							

Session 1B	Parallel 1B1	Parallel 1B2	Parallel 1B3	Parallel 1B4	Parallel 1B5	Parallel 1B6	Parallel 1B7	Parallel 1B8
Session Title	G. Advancing Theories in Triple Helix Model	H. Triple Helix Model for Government Institution & I. Strengthening National Innovation Policies in Developing Countries	J. Building Infrastructure (ICT)	J. Building Infrastructure (Food)	J. Building Infrastructure (Health)	J. Building Infrastructure (Techno Parks & Energy)	J. Building Infrastructure	J. Building Infrastructure
Room	Ayodya A	Ayodya B	Ayodya C	Ayodya D	Madhukara A	Madhukara B	Suralaya	Suralaya
Session Chair	Dr. Pri Hermawan	Andrzej H Jasinski	Dr. Mustika Sufiati Purwanegara	Prof. Loet Leydesdorff	Akbar Adhiutama, Ph.D	Jose Manoel Carvalho de Mello	Prof. Tariq S. Durrani	Harimukti Wandebory
16.00 - 17.30	175 (Calling for ABG (Academic –Business –Government) Leadership Early identification of effective characteristics of leadership to support Triple Helix Model)- **Yuni Ros Bangun**	146 (Outlook for the science, business and state interaction during the period of innovation economy development in Russian Federation.)- **Tatiana Pospelova**	89 (Creation of web infrastructure of regional innovation ecosystem in the Triple Helix model in Russia)- **Liana Kobzeva, Evgeny Gribov** ,Ivan Kuznetsov	190 (NGO: A Triple-Helix Axis (A Case Study in Nias Community Empowerment on Cocoa Production)- **Corinthias Pamatang Morgana Sianipar**, Kitri Widaretna	139 (Government Support in Triple Helix Collaboration to Provide Health Service Delivery: Case Study Government Hospital in Bengkulu Provinsi)- **Rachma Fitriati**, Krisna Puji Rahmayanti	32 (Asset Evaluation of The Brands of Technology Parks Operating in The State of Rio Grande Do Sul, Brazil)- **Juliana Panosso**	295 (According To The Needs Of Tourists with Quality Function Deployment (QFD) Method)- **Umi Zuraida**, R. Hari Harmoko	90 (The Model of Entrepreneurial University as Applied to Russia: The Case of TUSUR)-**Irina Pavlova**, Evgeniy Monastyrniy
	184 (Collaboration and Trust Building among Stakeholders in Citarum River Basin Conflict)- Utomo Sarjono Putro, Dhanan Sarwo Utomo, **Pri Hermawan**	261 (R&D and patents: An attempt of application of the Griliches's model in a transitional economy)- **Andrzej H Jasinski**	192 (Center of Tecchnology (COT) for Industrial Product Development through Collaboration and Partnership in Polytechnic Education)- **Mohammad Nurdin**	92 ("Triple Helix Model" for Fruits and Vegetables Supply Chain Management Development Involving Small Farmers in Order to Fulfill the Global Market Demand: a Case Study in "Value Chain Center (VCC) Padjadjaran University")- **Tomy Perdana** and Kusnandar	213 (Health Universal Access and Innovation: the Triple Helix approach in action)- Fernando Carvalho, **Monica Desiderio**,Carlos Morel	222 (Makassar Technopark, The Effort To Build A Synergy among University, Industry and Government as The Basic Investment To Implement The Innovation Systems)- **Bahrul Ulum Ilham**	107 (An Assessment of the Capability of ICT Education in Bicol University Polangui Campus, Polangui, Albay, Philippines: A Determinant to its Sustainability)- **Nelly Belchez**, Bernardita Rinon	88 (Brazil's opportunity to innovate in the field of sports)- Branca Terra, **Mariza Almeida**, Luiz Alberto Batista, Sérgio Ricardo Campos
	193 (Patterns of international mobility of researchers: evidence from the GlobSci survey)- Chiara Franzoni, Paula Stephan, **Giuseppe Scellato**	47 (Implementation of Green Economy in Telecommunication Industry: A Case Study of Bakrie Telecom)- **Arien Arianti Gunawan**	124 (The Core Competence and The Marketing Mix Strategy in Increasing Competitive Advantage and Its Impact on Marketing Performance at Telecommunication Service Companies)- **Endang Chumaidiyah**	127 (Strengthen a research cooperation using the Triple Helix Model: case study of poultry industry in Thailand)- **Kanlayanee Meesap, Wannaphop Klomklieng**	207 (Critical Review Triple Helix to Quinto Helix : Lesson learned from Social Security System Act Implementation in Indonesia)- Roy Valiant Salomo, Rachma Fitriati, Krisna Puji Rahmayanti	210 (The Development of A Methodology for Innovation Management at Utilities Companies at The Brazilian Electricity Distribution Sector)- Suzana Hecksher, Fernando Ferraz, Victor Gomes, **Jose Mello**, Thiago Pullig,Thiago Renault	138 (Triple Helix Concept in Disaster Management using Strategic Environmental Assessment: Case Study of Government Office Relocation Planning of Padang City, Indonesia)-**Eko Prasetio**, Yukni Arifianti, R. Bayuningrat, Fitriani Agustin	82 (Challenges & Succes Factors Analysis in Japanese Industry-Academic Cooperation Activities)- **Yaeko Mitsumory**
	259 (Identification of the Second Death Valley in Innovation Process in Korean Energy Sectors)- **Yong-Gil Lee**	135 (Developing Strategic Initiatives through Triple Helix Interactions: Systems Modelling for Policy Development)- **Yos Sunitiyoso**, Agung Wicaksono, Dhanan Sarwo Utomo, Utomo Sarjono Putro and Kuntoro Mangkusubroto	195 (Technology Readiness Analysis and User Segmentaion for IPTV Technology Adoption (Studies on Home Phone Users and Speedy PT. Telkom Indonesia in Bandung)- **Refi Rifaldi Windya Giri**	294 (Value Chain Analysis in Designer-Maker Industry:A Case Study of Bandung, West Java, Indonesia)- **Dina Dellyana**, Rustiadi Sonny	248 Brazilian Microelectronics Sector Dynamization: technology strengthening and sustainable development on production chains (Rúbia Auxiliadora Constâncio Quintão, Marco Antonio Silveira and Adalberto Mantovani Martiniano de Azevedo)	231 (Rehearsing Policy to Encourage Efficiency in Households' Electricity Consumption in West Java using Agent-Based Modeling)- **Devilia Sari**, Utomo Sarjono Putro, Dhanan Sarwo Utomo, Shinta Garsita Faridah	301 (Business-Perspectives Study For Lung Diseases Diagnosis Application)- Tjahjono Djatmiko, **Ria L. Moedomo**, Munawar Ahmad, M. Sukrisno Mardiyanto, Bachti Alisjahbana	293 (Promoting Innovation on Disaster-related Issues in Developing Countries) -**Pariatmono Sukamdo**, Pembayun Sekaringtyas, Zulkifli Halim
LO	Muslim Pribadi - 08122468428	Arien Arianti - 087822454244	Fransisca - 081910105679	Adita Pritasari - 0817401315	Enny Nur - 08562367774	Deru R - 081573406623	A.R Sofyandi - 081349206632	Nur HattaKrisna - 0811919838

The 10th Triple Helix International Conference 2012, Bandung, Indonesia
PARALLEL SESSION - Day 2 - 9 AUG 2012

Session 2A	Parallel 2A1	Parallel 2A2	Parallel 2A3	Parallel 2A4	Parallel 2A5	Parallel 2A6	Parallel 2A7	Parallel 2A8
Session Title	C. Implementation of Triple Helix Model In Entrepreneurship	D. Higher Education Role in Triple Helix	D. Higher Education Role in Triple Helix	E. Triple Helix Model for Developing Countries	E. Triple Helix Model for Developing Countries	F. Triple Helix Model for Innovation and Commercialization	K. Success Stories in Enhancing the Relevance of The Triple Helix Model	J. Building Infrastructure
Room	Ayodya A	Ayodya B	Ayodya C	Ayodya D	Madhukara A	Madhukara B	Suralaya	R. Meeting VIP Pakuan
Session Chair	Wawan Dhewanto, Ph.D	Achmad Ghazali, MBA	Prof. Dr. Jann Hidajat Tjakraatmadja	Dr. Ir. Budhi Arta Surya, MSc	Gatot Yudoko, Ph.D	Marina Ranga	Subiakto Soekarno, MBA	Andrzej H Jasinski
13.30 - 15.00	209 (Entrepreneurship Development: Collaboration among Education, Policy Makers, and Business.)- **Isti Raafaldini**, Arfiyah Citra Eka Dewi	159 (University and Small Medium Enterprise Linkage. A case study of Centre for innovation, entrepreneurship & leadership in Institut Teknologi Bandung)- **Akbar Adhiutama**, Rucita Cahyawati Putri, Nunik Rahyu	22 (University-industry joint-research: How do Indonesian industries perceive it?)- Nurul Indarti, **Fathul Wahid**	53 (Relationship Among Soft Skill, Hard Skill and Innovativeness of Knowledge Workers in Developing Country)- **Achmad Fajar Hendarman**, Jann Hidajat Tjakraatmadja	100 (The development of innovation in the odontology field in Brazil)- Cristina Almeida, **Mariza Almeida**, Antonio Botelho	219 (Sources of Information and Its Effect on Novelty of Innovation: Case of Manufacturing and Services Sectors in Nigeria)- Omolayo Oluwatope, David Adeyeye, Maruf Sanni	33 (Lessons from Technology Transfer Activities in Japan)- **Mitsuaki Hosono**, Yasuo Nakayama	215 (Role of Social Media in Triple Helix to Support a New Paradigm in The Field of Technology as The Efficient and Effective Learning Media in Higher Education)- Adhi Gurmilang, Willy Riantoputra, **Arus Reka Prasetia**
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15.00 - 15.30	Coffee break							
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Session Title	A. Triple Helix in Art, Design, and Culture	B. Triple Helix Collaboration for Small and Medium Enterprises	F. Triple Helix Model for Innovation and Commercialization	F. Triple Helix Model for Innovation and Commercialization	G. Advancing Theories in Triple Helix Model	I. Strengthening National Innovation Policies in Developing Countries	J. Building Infrastructure	J. Building Infrastructure
Room	Ayodya A	Ayodya B	Ayodya C	Ayodya D	Madhukara A	Madhukara B	Suralaya	R. Meeting VIP Pakuan
Session Chair	Herry Hudrasyah, MA	Leo Aldianto, MBA, M.Sc	Subiakto Soekarno, MBA	Dr. Yuni Ros Bangun	Donald Lantu, MBA	Dr. Ir. Budhi Arta Surya, MSc	Dr. Aurik Gustomo	Wawan Dhewanto, M.Sc
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	228 (Preserving Angklung as Sundanese Cultural Heritage Through Triple Helix Collaboration: a case study of Saung Angklung Udjo)- **Ummu Hani**, Irna Azzadina, Estav Huda Setyagung, Corinthias Pamatang Morgana Sianipar, Tomohisa Ishii	12 (Agriculture Beyond Food a scientific program exploring the potential of biomass)-Huub Loffler, Rudie Trienes, Cora Govers, **Enny Sudarmonowati**	148 (Creative Learning and Research Through Modern Board Game)-**Eko Nugroho, Adieb Aryasepta Haryadi**	292 (Towards endogenous development in Indonesia: An insight of university – industry – government collaboration in innovation for development)- **Ary Mochtar Pedju**	6 (Shortcoming of the Triple Helix Paradigm: a Critical Analysis with respect to the Developing World)- **Manishankar Prasad**	212 (Agent-based Modeling on Rice Production for Policy Making. Case Study : Garut, West Java, Indonesia)- Pri Hermawan, Dhanan Sarwo Utomo, **Shimaditya Nuraeni**	84 (Potential Market for Eco Label Paprika in Indonesia)- **Eldelweijs Putri**, Gatot Yudoko, Kiyoshi Dowaki	182 (GM crops and the end users: communicating innovation at grassroots level)- **Poonam Pandey**
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Victoria E. Erosa	University of Applied Sciences, Hochshule, Bremen	Germany

52. Wooden Heritage Restoration Program Illustrating the Triple Helix interaction in Tomsk Region (Russia)

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Nikita Kirsanov	Tomsk City Administration	Russia

113. Developing Triple Helix Schemes in Tourism: A case study on a Tanzanian University

Martin Kunc	University of Warwick	United Kingdom
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Eko Nugroho	Statistics Department Universitas Padjadjaran	Indonesia
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208. Feliz Deserto's Local Innovation System: characterising or mischaracterising local handicrafts in Brazil?

Durval Lucas Jr	Federal University of São Carlos	Brazil
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220. Promoting Value Co-creation Process within Garut Leather Jackets Industrial Cluster using Agent-Based Modeling and Simulation Methodology

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228. Preserving Angklung as Sundanese Cultural Heritage Through Triple Helix Collaboration: a case study of Saung Angklung Udjo

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294. Value Chain Analysis in Designer-Maker Industry: A Case Study of Bandung, West Java, Indonesia

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B. Triple Helix Collaboration for Small and Medium Enterprises

3. Qualitative Approaches as Formative Evaluations: The Missing Link in the Public Support to SMEs

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4. The Improvement of the Public Assistance to SME Innovation: The Role of Governments, Universities, and Industry

Arturo Vega	Canterbury Christ Church University	United Kingdom
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61. Role of intermediaries in accelerating the transformation of inter-firm networks into Triple Helix networks:

A case study of SME-based industries in Thailand

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133. The Small and Medium Business Cluster Growth Model

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147. The Development of Islamic Financing Scheme for SMEs in a Developing Country: The Indonesian Case

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217. Investments and Financing SME Growth. Capital as Moderator Variable between Entrepreneurship and Small Enterprise Performance

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C. Implementation of Triple Helix Model In Entrepreneurship

2. Research-Based Entrepreneurship

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36. Entrepreneurial capabilities in a Brazilian university: the case of the federal university of Rio de Janeiro

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48. From "Family based" to "Industrial based" production Combining the triple Helix model and "Empowerment" in a LED approach.

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136. Asset Allocation and Periodically Rebalancing Strategy to Improve the Investment Return Performance: A study of the portfolio return using Indonesian Panin Mutual Funds for the period of 2005-2009

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90. The Model of Entrepreneurial University as Applied to Russia: The Case of TUSUR

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209. Entrepreneurship Development: Collaboration among Education, Policy Makers, and Business.

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300. Entrepreneurial Culture and Leadership in Public and Private Institutions in Indonesia

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D. Higher Education Role in Triple Helix

20. Production-based Education (PBE): The Future Perspective of Education on Manufacturing Excellence

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22. University-industry joint-research: How do Indonesian industries perceive it?

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35. A Study on Strategic University-Industry Collaboration

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215. Role of Social Media in Triple Helix to Support a New Paradigm in The Field of Technology as The Efficient and Effective Learning Media in Higher Education

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244. Current Status of Academia-Industry Interactions in The Nigerian Pharmaceutical Innovation System

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E. Higher Education Role in Triple Helix

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95. Cooperative of Ballot as an Instrument to Bring People Sovereignty for Foundation of Triple Helix in Developing Countries

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98. Advancing the Small and Growing Business (SGB) Movement in Colombia: ImpactA a SGB collaborative multiactor Acceleration Program

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100. The development of innovation in the odontology field in Brazil

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112. Taking a Bottom-Up, Design Approach to Indonesia's Wicked Problems

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131. Triple Helix Collaboration to Develop Economic Corridors as Knowledge Hub in Indonesia

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193. Patterns of International Mobility of Researchers: Evidence from the GlobSci survey

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216. Program to Promote Investment in Technology-Based and Innovative Companies: An Example of a Program Inspired in The Triple

Henry Mora	Colombian Observatory of Science and Technology	Colombia
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229. Heterogeneity in firms' innovation activities: Size, ownership and sector do matter

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238. Strengthening National Innovation Policies in Developing Countries: New approaches for Analysing National Innovation Systems in Emerging and Developing Countries – ANIS

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240. Does Environmental Regulation Foster The Diffusion of Collaborative Innovations? A Study on Electronics Waste Regulation

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259. Identification of the Second Death Valley in Innovation Process in Korean Energy Sectors

Yong-Gil Lee	INHA University, Korea	Korea

292. Towards endogenous development in Indonesia: An insight of university – industry – government collaboration in innovation for development

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G. Advancing Theories in Triple Helix Model

5. Governance of Triple Helix Relationships: Principles of Intermediation, or Who is in Control When the State, The University and The Industry Interact?

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6. Framing STS in The Developmental Context: A Post-Triple Helix Approach

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DEALING WITH CULTURAL ISSUES IN THE TRIPLE HELIX MODEL IMPLEMENTATION: A COMPARISON AMONG GOVERNMENT, UNIVERSITY AND BUSINESS CULTURE

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Abstract
Implementing a model to foster the interaction among Government, Academy and Business seems to require more than the model definition and the expected operational programming and budgeting. The concept of Triple Helix as innovation strategy is based in the participation and collaboration of three entities with different objectives, being a common goal setting considered as the means for harmonization of the cultural diversity involved in the activities of the three partners. While Government Policies, Norms and Regulations works in a cultural environment characterized by structured guidelines, compulsory duties and control, University activities are guided by the knowledge creation and diffusion usually taking advantage of the open environment prevailing. Business culture has as main difference the profit orientation and the efficiency search in order to create value to the shareholders. Under these different objectives, Governments are economic development oriented, Universities are knowledge oriented and Businesses are profit oriented, representing three cultural operational environments. To understand the complexities of the cultures that must work together to foster innovation results, a research study was conducted using Hofstede´s Cultural Dimensions as a main analytical framework to identify the culture characteristics of each one of the parties involved in a Triple Helix operational Model.

Keywords: Government; University and Business Culture; Cultural Dimensions; Innovation Policy; Innovation Strategy

WOODEN HERITAGE RESTORATION PROGRAMME ILLUSTRATING THE TRIPLE HELIX INTERACTION IN TOMSK REGION (RUSSIA).

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Abstract
Tomsk region and Programme of preservation of Tomsk wooden architecture is a vivid example of effective collaboration of government institutions, universities and private companies. In the article the reader will find the guidelines for different types of interaction between institutions for preservation of historical heritage within the "Triple Helix" model. The author will also present some examples, illustrating in detail the universality of this interaction model and the possibility of its application for conservation of architectural heritage in other cities, facing the same problem of loss of architectural monuments.

Keywords: wooden architecture; cultural heritage; preservation; co-financing; governmental Programme.

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DEVELOPING TRIPLE HELIX SCHEMES IN TOURISM: A CASE STUDY ON A TANZANIAN UNIVERSITY

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Abstract
Tourists are demanding more sophisticated tourism products: adventure, cultural and learning experiences. In developed countries, new tourism products are being created to satisfy tourists' requirements. However, developing countries are behind this trend even though they are endowed with highly valuable naturals resources and historical places. Universities can take an important role to promote sophisticated tourism products in developing countries through innovation and entrepreneurship. We present a case study of a Tanzanian University that wanted to develop its capabilities to implement a Triple Helix scheme. Lessons from the case study are discussed.

Keywords: Universities, Tourism, Tanzania

Introduction

Tourists are demanding the development of niche products and creative innovations that increase the quality of tourists' experiences and satisfaction (Bardolet & Sheldon 2008). Innovation and entrepreneurship have helped to develop the reputation and advancement of the international tourism industry (Getz & Carlsen 2005) particularly through alternative tourism offers, e.g. eco-tourism and cultural tourism, that satisfy tourists' demands. However, large companies generate many innovations in tourism without generating benefits for the local communities (except poorly paid employment opportunities), e.g. all-inclusive resorts. Among other benefits, local innovation and entrepreneurship help link tourism benefits to the local economy and encourage the development of local enterprises creating more wealth (Ashley 2006). However, the practice of entrepreneurship and innovation in tourism strongly differs between developed countries and developing countries due to, among other reasons, the lack of support to tourism SMEs (Rogerson 2007).

Institutions, such as universities, can play an important role supporting entrepreneurs and fostering innovation in developing countries by providing knowledge, networks and incubating business. However, there is limited evidence of the role taken by university fostering tourism. In a recent study, Kunc and Tiffin (2011) presented a series of performance indicators of the activities that universities have with their local tourism industry. However, they did not present a detailed analysis of the processes followed. This paper complements Kunc and Tiffin (2011) by analysing the initial stages of the implementation of a Triple Helix scheme in the area of tourism. The paper employs a case study related to a university located in Tanzania.

Innovation and entrepreneurship in tourism

Changing trends in tourists' lifestyles, holiday and work patterns have supported new innovations in the tourism industry and provided opportunities for companies to respond to the motivations of tourists that seek quality in adventurous, educative and learning experiences (Novelli 2005). Many studies, e.g. Novelli (2005), suggest the success of innovation in tourism rests upon the dual innovative and entrepreneurial skills of the owner of the firm and his or her ability to respond to the fast-changing sophisticated expectations of experienced tourists.

Hjalager (2010) performs an analysis of the innovations in tourism distinguishing five different types of innovation:

- products (e.g. new hotel services or new attractions in a destination);

- methods of production; (e.g., identifying new customer segments or improvements in tour guiding which enhances the quality of the tourist experience);
- sources of supply (e.g. diversifying to new niche tour operators);
- new markets (e.g. redirecting existing destination brands to cater for new markets) and new ways to organize business.

Another way of identifying innovation in tourism is to categorise them according to how radical they are compared to current business processes (Blichfeldt, 2009). Continuous improvements are often characterized as incremental innovations, such as improving the customer service in a hotel. Radical innovations in tourism imply a whole redesign of a certain tourism product, such as all-inclusive packages when they appeared many years ago.

However, innovation and entrepreneurship in tourism can strongly differ from traditional ways of innovation. For example, many tourism entrepreneurs in ecotourism follow lifestyle preferences (Getz & Carlsen, 2005). Lifestyle entrepreneurs in tourism are motivated by different factors compared to entrepreneurs whose motivations are business-oriented (Parra Lopez et al., 2009). Lifestyle entrepreneurs are a source of innovation since they are highly experienced users of tourism services but they may lack a professional approach to the tourism business (Peters et al., 2009). . Consequently, an eco-tourism destination may not necessarily reach its full potential or become sustainable by only receiving lifestyle entrepreneurs. In developing countries, tourism is usually associated to the creation of wealth given its labour intensity. Eco-tourism, or any variation of niche tourism, provision via indigenous SMEs has the potential to enhance destination competitiveness and create better links to the local economy (Meyer, 2010).

Innovation in niche tourism clearly requires more advanced knowledge and skills than conventional tourism, or tourism as a style of life, because it involves the adaptations of local products, such a conservation area or an archaeological site, and services to enhance the tourist experience (Stamboulis & Skayannis, 2003). However, this is a key issue for developing countries where destination residents may not have access to develop such skills and knowledge. For example, eco-tourism requires knowledge related to nature conservation and how to provide an educational experience to the visitors not only in terms of ecology but also in terms of socio-cultural differences of attitudes and expectations (Weaver & Lawton, 2007). Even adventure tourism activities require recognisable commercial approach, e.g. adaptation to customers' requirements and the development of brands, to attract more diverse tourists including conservation tourists (Cousins, 2007). Niche tourism is an area where universities can provide a strong support to local entrepreneurs.

Limitations to entrepreneurship and innovation in tourism: the role of networks and universities

One of the important limitations to innovation in tourism is the small size of many firms in the industry (Pikkemaat 2008) and the fragmented nature of the industry. Tourism entrepreneurs may benefit from collaborative networking amongst stakeholders to develop their business ideas (Van der Duim, 2007) as well as facilitate the transfer of advanced knowledge (Nordin 2003). Tiffin and Bortagaray (2008) suggest that the development of clusters around niche tourism propositions may allow the pooling of resources from different entrepreneurs, local government and development agencies to increase the efficiency and development of firms in a certain tourist area. The importance of effective alliances and network formation between public and private sectors within the tourism distribution system are integral to the implementation of responsible tourism principles and competitive tourism products (Milne and Ateljevic, 2001). Arnaboldi and Spiller (2011) suggest stakeholder collaboration is key to establishing networks. This reflects the process of knowledge acquisition by finding existing knowledge, understanding requirements, searching among multiple sources and learning through strategic alliances and inter-firm collaboration for utilising resources. Triple Helix models can provide the answer to this issues.

Triple Helix models support the collaboration between the public and private sector and academic institutions to support knowledge creation, innovation and growth in knowledge-based firms (Etzkowitz, 2008). The main aims is to transfer knowledge to promote the diffusion of ideas from universities, e.g. new discoveries in archaeological sites, adding value to the private sector via innovation as well as supporting the entrepreneurs in their beginnings (Kunc and Tiffin, 2011). In a Triple Helix context, the pooling of resources and development of a shared vision to develop a tourism destination is a role that academia and the public sector can take (Etzkowitz, 2008) while industry remains a key actor in term of implementing the innovations through production and service delivery. Entrepreneurial universities take the leadership by formulating and implementing a strategic vision for the region, organising the transfer of knowledge through incubation of new firms and educating students with an entrepreneurial ethos (Etzkowitz, 2008; Kunc and Tiffin, 2011).

However, the process of establishing a Triple Helix model is an area that more evidence is necessary to identify successful policies and practices. The next section presents a case study where the authors started the process of developing a Triple Helix model in tourism in a developing country.

Case Study: Sokoine University, Wildlife Department – Morogoro, Tanzania

In Tanzania the authors designed and delivered an innovation and entrepreneurship programme to faculty staff of Sokoine University in the department of wildlife management. The department has launched three years ago a bachelor programme integrating wildlife management and tourism combining their extensive knowledge in wildlife with tourism by hiring a group of faculty with tourism degrees. The Triple Helix model inspired the design process of the course. 30 attendees were selected to cover the three parts of the triple helix: universities, industry and government. The four-days workshop covered the functions of each actor with a continuous reference to how to embed innovation in local tourism destinations and promote entrepreneurship to increase the impact of tourism on local economic development through workshops. The discussions identified potential entrepreneurial proposals with a view of engaging the multiple stakeholders in a destination.

Wildlife tourism is the main tourism attraction in Tanzania, and one of the mainstream tourism themes in commercial tourism (Higham & Shelton, 2011), since Tanzania has 26% of land in a protected natural state (72 parks) including the famous Serengeti National Park. Tanzania has more pristine nature tourism resources than Kenya and a large number of tourists arriving to Tanzania for wildlife tourism come through the Tanzania-Kenya border (URT 2009) to perform the Northern circuit tour which includes Arusha, Kilimanjaro and Serengeti. However, Tanzania still depends on the tourists arriving to Kenya for nature tourism because the lack of development of wildlife tourism. In an initial study, Tiffin (2010) found that the number of local entrepreneurs in tourism in Tanzania was very low and most of them were based in Tanzania's capital, Dar-es-Salaam. Tanzania's capital is far away from wildlife assets to be used as a base to enjoy wildlife tourism. Additionally, Tiffin (2010) observed that universities teaching tourism were mainly oriented towards skills training, i.e. hotel and restaurant services, rather than encouraging students to start new firms through entrepreneurship.

Selecting a university for building innovative and entrepreneurial capacity in wildlife tourism is aligned with the concept of universities as drivers of Triple Helix collaborative frameworks (Etzkowitz 2008). Universities are key actors because of their autonomy to define their strategic direction and facilitate the creation of projects involving multiple stakeholders (Kunc & Tiffin, 2011). Therefore, building capacity in Sokoine University, which is directly related to wildlife management, is a priority to develop the full potential that wildlife tourism has in Tanzania (Burns & Howard, 2003). Sokoine University is embedded in the Southern Circuit for wildlife safaris. The parks of the South are vast, e.g. Selous Natural Reserve has an area of 500000 km2, and offers a more remote wildlife experience than widely popular parks of the Northern circuit. However, the Southern circuit is under developed. While Sokoine University has extensive knowledge about wildlife management, it does not have expertise in transforming this knowledge into innovation and entrepreneurship in tourism related to wildlife assets.

The process of designing the programme has provided a number of insights in the process of building collaborative frameworks in tourism. While the program contains an entrepreneurship development component similar to programs run in developed countries, it differs in its holistic and systemic management approach (Arnaboldi & Spiller 2011). The program considers not only the role of the entrepreneur generating a new innovation in the market but its integration with other actors in the destination, such as communities, government agencies and complementary products (Saxena, 2005). The program was particularly aimed at building the capacity of local professors/lecturers to develop entrepreneurs within the students studying a bachelor in wildlife tourism. However, to identify relevant material for a group of faculty without background in business was challenging. Moreover, to promote innovation that can come from the integration of the research in wildlife with new tourism products and services was a concept alien to them. The faculty was oriented towards the traditional model of training students in subjects rather than encouraging their creativity to design new services or products.

The success of entrepreneurship development programs, which constitute the industry sector in a triple helix model, depends on economic (financial support), political (policies and programs providing adequate tax incentives and funds) and social conditions (cultural barriers) in addition to simply teaching entrepreneurship (Kunc and Tiffin, 2011). Thus, the workshop was also designed to involve people from other institutions responsible for financial assistance: the national bank, foreign donors' agencies and political support such as ministries related to tourism and development to address economic, political and social issues.

The workshop and the innovations identified

The programme began with the analysis of tourism providers existing in the local tourism industry, which provide the infrastructure for experience-based tourism (Stamboulis & Skayannis 2003). The exercise was designed to allow participants to understand the characteristics of a particular actor and the strengths and weaknesses within the operation of the chosen organization. Participants selected examples of hotels, travel agents and tour guides showing the usual problems in the industry: excessive number of firms in similar tourism services and lack of innovation and professionalism in their approach.

Then, the participants moved to take a multi-stakeholder view of the experience that these service providers were providing to tourists. In this stage, we encouraged participants to identify additional stakeholders that can enhance this experience such as local organizations and government institutions responsible for the conservation of wildlife, i.e. park rangers, researchers from the university, and other companies that can be involved in offering to the tourist not only a safari but also additional aspects of the wildlife experience including local culture such as local handicraft producers, literature and music related to local communities integrated with the wildlife environment. This stage was quite illuminating for the participants as they started recognising the existence of additional participants within a destination and the importance of networks and collaboration with other actors in the destination.

The final day was concentrated on the implementation of the framework through a series of activities that highlight the importance of a multi-stakeholder view in innovating in tourism. Participants mapped out the actors in the clusters and their relationships in terms of strength. Participants were able to think outside the tourism service provider to look at the industry in a holistic way identifying the contributions of the three actors in a triple helix model.

The building capacity project has made an important contribution to develop skills in the faculty and raise awareness among supporting actors to the development of entrepreneurs. However, the main impact was in the university as the university would engage in a series of activities to develop the collaborative framework such as curriculum review and development of additional programmes centred in innovation and entrepreneurship; involvement of real entrepreneurs in teaching or coaching students; development of research programmes embedded in the wildlife areas involving all stakeholders with the aim to support local tourism firms; establishment of a business park, incubation unit and resource centres providing support to existing and new firms; and develop networks with regional, national and international actors in the tourism and related industries.

The participants identifed a number of innovations for their local areas. We are going to present one of them: canoeing in a remote lake in a biosphere protected area.

Canoeing business. A group of participants identified the establishment of a canoeing tourism area in a remote lake in Tanzania. The indigenous people have been canoeing in this lake for centuries and they have developed their own canoes using local trees. The idea was to promote adventure tourism through the use of indigenous knowledge about the area and their own methods to develop canoes rather than buying canoes. This group of participants identified key stakeholders in this new business, see figure 1. The solid lines represent strong linkages between the actors and the broken lines reflect occasional relationships. For example, the canoeing business will have a strong link with an education institution to educate its own tour guides in terms of conservation practices and identification of local plants and animals (Sokoine University also has a Forestry department). The canoeing business should establish long-term links with the local canoe makers to identify ways of improving safety in their design of canoes and providing canoes on time. The canoe makers will also be responsible for the informal training to tourists to manage canoes. Given the status of protected area, the canoeing business will require support from the university in terms of research to identify environmental impacts on the area. One important aspect that research can provide is the analysis of the sustainability of canoe making since it implies the use of local trees.

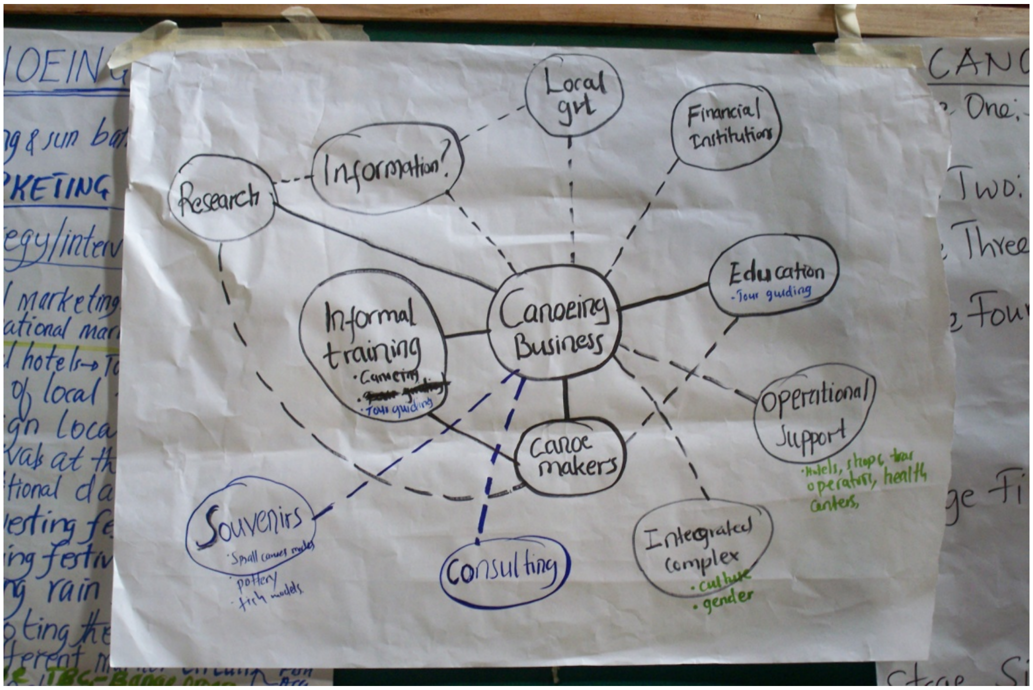

Figure 1. A Triple Helix view of an experience-based tourism in Canoeing

Additional actors with relatively less intense linkages to the canoeing business but very important are: souvenirs, consulting, integrated complex, operational support, financial institutions and local government. Souvenirs can provide income to local artisans specialized in pottery and other crafts while maintaining the authenticity of the tourism experience. Thus, the importance that they are integrated into the experience that the tourists have during the canoeing trip. Consulting firms can provide support in terms of identifying markets and ways of promoting canoeing tourism to foreign tourists. Integrated complex are other local actors that complement the tourism product through the cultural and gender dimensions, for example visiting villages as part of the canoeing experience. Operational support involves companies that are not directly related to the canoeing experience but they support its development. For example: hotels, tour operators in other areas to bring the tourists and health centers (in case of accidents). Financial institutions are key to provide the initial support to the business in terms of financial needs and transactions with foreign tourists. Finally, local government represented by park rangers and local regulations can either generate important barriers or enhance the development of the business while implementing active sustainable policies.

Conclusions

The program was a successful initial step in developing a Triple Helix scheme. New ideas were developed about the implementation of tourism products based on the knowledge existing in the university using a holistic approach involving all actors of the Triple Helix model. We feel participants learned a great deal about the processes existing in the field as well as how to conceptualize the process of designing an entrepreneurial venture based on knowledge in tourism.

While there was an initial scheme to deliver the programme, there were some modifications on the spot related to better focussing of the interactive workshops. We noted significantly less intervention in class occurred from the participants than we expected. Many of the concepts appeared to be very novel to many of the students. They seemed to have had very little prior exposure to some of the key ideas. This is on one hand a reason for doing the course, but on the other hand, it means that the course might have covered too much too fast.

We suspect that it would take significantly more effort and time to generate strong learning and a proactive university using a Triple Helix model. After the workshop, we asked the university to develop a proposal for a donor agency applying the concepts learned. We observed that they seemed to have experience mainly as academics rather than entrepeneurial, although some of them have their own firms such as a hotel, so the proposal lacked of the ambition necessary for an entrepreneurial university (Etzkowitz, 2008; Kunc and Tiffin, 2011). We plan to review their developments in the near future.

References

Arnaboldi, M. and Spiller, N 2011. Actor-network theory and stakeholder collaboration: The Case of Cultural Districts. Tourism Management, 32, 641-654.

Ashley, C., 2006. How Can Governments Boost the Local Economic Impacts of Tourism? SNV Tool Kit for East and Southern Africa. London: Overseas Development Institute

Bardolet E. and P.J. Sheldon 2008. Tourism in Archipelagos Hawai'i and the Balearics. Annals of Tourism Research, 35 (4) 900–923.

Blichfeldt, B. S. 2009. Innovation and Entrepreneurship in tourism: the Case of a Danish Caravan Site. PASOS Revista de Turismo y Patrimonio Cultural 7 (3) 415-431.

Cousins, J.A. 2007. The Role of UK-based conservation tourism operators. Tourism Management, 28:1020-1030.

Etzkowitz, H. 2008 The Triple Helix: University-Industry-Government Innovation in Action. Routledge, New York: USA.

Getz, D. and Carlsen, J. 2005. Family Business in Tourism State of the Art. Annals of Tourism Research, Vol. 32, No. 1, pp. 237–258.

Hjalager, A.M. 2010. A review of innovation research in tourism. Tourism Management 31, 1-12.

Higham, J.E.S and Shelton E.J. (2011). Tourism and wildlife habituation: Reduced population fitness or cessation of impact? Tourism Management, 1-9.

Kunc, M. and Tiffin, S. 2011. Defining and measuring the roles universities play in regional innovation systems: a comparative study of Chile and Canada focusing on natural resource based clusters. Science and Public Policy, 38: 55-66

Meyer, D. 2010. "Propoor Tourism: Can Tourism contribute to Poverty Reduction in Less Economically Developed countries? Cole, S and Morgan, N. (eds) Tourism and Inequality: Problems and Prospects. Cabi Publishing.

Milne, S. and Ateljivic, I 2001. Tourism, Economic Development and the Global-local nexus: Theory embracing complexity. Tourism Geographies 3 (4) 369-93.

Nordin, S. (2003) Tourism clustering and innovation. Östersund: ETOUR.

Novelli, M. 2005. Niche Tourism: Contemporary issues, trends and cases Oxford: Elsevier Butterworth-Heinemann.

Parra Lopez, E.; Buhalis, D and Fyall, A. 2009. Entrepreneurship and Innovation in Tourism. Pasos – Revista de Turismo y Patrimonio Cultural 7 (3) 355-357.

Pikkemaat, B (2008) Innovation in small and medium-sized tourism enterprises in Tyrol, Austria. Entrepreneurship and Innovation, 9(3), 187-197.

Rogerson, C.M. 2007. Supporting small firm development in tourism South Africa's Tourism Enterprise Programme. Entrepreneurship and Innovation 8 (1) 6–14

Saxena, G. 2005. Relationships, Networks and the Learning Regions: Case Evidence from the Peak District National Park. Tourism Management, 26:277-289.

Stamboulis, Y and Skayannis, P 2003. Innovation strategies and technology for experience-based tourism. Tourism Management, 24: 35-43.

Tiffin, S. (2010). Tanzanian Tourism Industry Innovation Cluster Building Project. UNESCO, Dar-es-Salaam, Tanzania.

Tiffin, S. and Bortagaray, I. 2008. Innovation Clusters in Latin America", in Haar, J. (ed.) Can Latin America Compete? Confronting the Challenges of Globalization. London and New York: Palgrave Macmillan.

United Republic of Tanzania (URT) 2009. Tourism Statistical Bulletin. Ministry of Natural Resources and Tourism, Dar es Salaam. Van der Duim, R. 2007. Tourismscapes: An actor network perspective. Annals of Tourism Research, 34 (4).961-976.

Weaver, D.B. and Lawton, L.J. 2007. Twenty years on: The state of contemporary ecotourism research. Tourism Management, 28: 1168-1179.

CREATIVE LEARNING AND RESEARCH THROUGH MODERN BOARD GAME

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Abstract. In the last decade, board game industry has been rapidly growing. It was started by the introduction of the German style board game, also known as modern board game, in the United States and Asia. The modern board game with its special characteristics: specific themes, creative gameplay, and unique design, has brought the industry to the whole new level. More interestingly, those characteristics unlock other potential values of the modern board game beyond the entertainment area. In this paper we discuss potential values of modern board game, not only as an entertainment media, but also as an educational media and a research tool. The first part of the paper presents some definitions, studies on modern board game, its characteristics, and its potential value as a creative industry. Later part on the paper we discuss the social interaction value, the information sharing level, its impact on motivating collaboration, and the engagement level created by the modern board game. Moreover we argue that it is the particular combination of highly valuable content (themes and design), intellectual engagement created by the creative gameplay, and the structured social experience offered by these games are the key to unlock their potential values. In the last part of the paper we discuss the innovative approach, using modern board game and interactive play, to improve the effectivity of learning and research process in developing country.

Keywords: Board Game, Social Game, Game Design, Social Interaction, Interactive Learning Process.

1 Introduction

Board games are a complex form of games. They consist of boards and various kinds of pieces (dice, pawns, counters, etc.), a system of rules, and most importantly players. The game can be based on pure strategy, chance (e.g. rolling dice), or a mixture of the two. There are many different types and styles of board games, some having no inherent theme and some do have a specific theme and narrative. Board games form an integral part of civilization representing an application of abstract thought by the masses, the ability to play board games well has long been regarded as a sign of intelligence and learning. Many generations have taken up the challenge of board games across all cultures, creeds, and times.

The ancient Egyptians played board game called Senet as a form of recreation, and was to evolve into a profound ritual, a drama for ultimate stakes. Mehen is another form of board game that was also found in the Ancient Egypt. The world's oldest Backgammon discovered in Burnt City, southeastern Iran. Some studies show that those games have been invented and played since 5000 years ago [12][1]. Go, Mancala, and Chess are some traditional board game that still existed and their origin can be traced to some ancient civilizations.

The invention the Landlord game by Elizabeth Magie in 1903 has opened new era of board game. The game was not only intended as a recreation tools, it was also serve as learning tools, as a media. Through the game she intended to show that rents enriched property owners and impoverished tenants. She knew that some people would find it difficult to understand the logic behind the idea, and she thought that if the rent problem and the Georgist solution to it (that things found in nature, most importantly land, belongs equally to all) were put into the concrete form of a game it will make it much more easier to understand. Later on the game was published in the United Kingdom in 1913. Shortly after the game's publication, Scott Nearing, a professor in the Warton School of Finance at the University of Pennsylvania began using the game as a teaching tool. More interestingly, his students start to make their own boards, and taught the game to others. Some years later, Rexford Tugwell, one of Professor Nearing's Student also taught the landlord game in Warton, and took it with him to Columbia University [10]. The game kept spreading and gained its reputation, mainly because of its ability to deliver a complex concept in a creative and more effective way. Today, the latest variation of the game is known as Monopoly. Prior to 1980 the board game market in US and Europe were not very different, but the launch of the Spiel des Jahres award in 1979 and the start of the Essen games fair in 1983 spurred new creativity in European game design, particularly in Germany. Between 1982 and 1994 the German game market experienced strong growth, often at a rate of 10% or more. A number of newer imprints were introduced by more established publishing houses, whilst others came from new companies entering the growing market. Since that time the so-called German-Style board game or Eurogames was established as a new genre in the board game market. In contrast with board games developed in United States which tend to motivate direct conflict between players, German-Style board games tend to let players win without having to undercut or destroy their opponents. This particular characteristic provide new and wider perspective of how a board game can be played. Board games have played an important role as research objects in the science of this century. At first, games and board games were studied from a historical perspective. In 1944, Von Neumann and Morgenstern provided a basis for using games and board games in the computer sciences and in economics, such as in the field of game theory [11]. Research on board games accelerated with research on chess, in particular chess masters, which has proved fundamental in the cognitive sciences since Adriann de Groot [5], followed by Newell & Simon [9] and others. Chess is still dominant in most fields but slowly other championship games enter these fields as examples or tools in research. Another reason why board game play important role in learning and research process is because its simplicity in design process and its high interactivity between players, since most board games are usually played by more than just one player. These are some reasons why we use believe that board game can be optimized as learning and research tools:

1. Through board game we have the opportunity to present a simplified models of real life problems.
2. In board game, there is exist tried-and-tested methods for comparing the strengths of different players, different situation, different parameter, allowing for them to be used as a sample to compare and understand different approach to the problem.
3. Board game provide high level interactivity which is necessary to transform any data collecting process to be fun and enjoyable.Through this paper we will discuss the possibility of using modern board games to enhance creative learning and research processes. What we mean with modern board games are those board games that were developed from the beginning of the 20th century up to today. Bythis restriction we exclude (abstract) games such as Chess, Mancala, and GO, from our discussion. In the following section we will discuss three major element of modern board games: theme, gameplay, and artwork. Later on, we argue that by optimizing those elements we can use board games as an effective learning and research media.

2 Elements of Modern Board Game

We are now ready to discuss three major elements of modern board games that important for our purpose using board game as learning and researches tools. Those three elements are: theme, gameplay, and artwork. By understanding those elements, later on we will be able to optimize their impact and transform our board game into an optimal learning and research tool.

2.1 Theme

As we mentioned in the previous section some board games have no inherent theme while some do have a specific theme and storyline. The theme presented by the game can be seen as the information that we want to deliver for the player. In some situations it can just a “make up ”to make the game more interesting for the players. Whatever the purposes of presenting a theme, it helps to deliver a motivation to play, and that is a reason why most of modern board games indeed are developed with strong theme. In 2010, we have done small project of designing a board game called Simpang Dago. Simpang Dago is a location in Bandung area which is known for its traffic jam, crowded market, and piled up garbage. The idea is trying to use board game as a media to introduce another interesting aspect of Simpang Dago, which is its culinary. The game is equipped with a story line (theme) that each players is hunting delicious foods around Simpang Dago. The game was tested and distributed to several people. The majority respond after playing the game is that people tend to be more aware about the culinary aspect in Simpang Dago. The project highlighted one of potential use of theme to deliver new information effectively. Event though theme and story line is an important element, we should not think of games as a storytelling medium. This method of thinking will leads to futile attempts to straight jacket games, to make them more effective stories at the expense of its gameplay. Instead, game designers should use story elements to strengthen their games when appropriate, but should not be afraid to shy away from story entirely, at times. Because ultimately, what a player takes away from a game is not the story it tells (if it tells one at all), but modes of thought and ways of attacking problems, and a sense of satisfaction at mastery.

Figure 1: Simpang Dago - Board Game

2.2 Gameplay

Game designers and game scholars generally use the word mechanic to describe, in a vague sense, what it is that players do during the play of a game. Salen and Zimmerman describe the core mechanic of a game as “the essential play activity players perform again and again in a game”(2004, p.316). In these terms, the game mechanic describes the principal functional interaction form with either the game system or other players. In multiplayer competitive games, this interaction is primarily concerned with the achievement of the game goal. Järvinen [8] to conclude that: “mechanics is a functional game feature that describes one possible or preferred or encouraged means with which the player can interact with game elements as she is trying to influence the game state at hand towards attainment of a goal.”

The following game mechanics was taken from boardgamegeek.com:

_ Action Point Allowance System
_ Area Control / Area Influence
_ Area Enclosure
_ Area Movement
_ Area-Impulse
_ Auction/Bidding
_ Betting/Wagering
_ Campaign / Battle Card Driven
_ Card Drafting
_ Chit-Pull System
_ Co-operative Play
_ Commodity Speculation

_ Crayon Rail System
_ Deck / Pool Building
_ Dice Rolling
_ Hand Management
_ Hex-and-Counter
_ Line Drawing
_ Memory
_ Modular Board
_ Paper-and-Pencil
_ Partnerships
_ Pattern Building
_ Pattern Recognition
_ Pick-up and Deliver
_ Point to Point Movement
_ Press Your Luck
_ Rock-Paper-Scissors
_ Role Playing
_ Roll / Spin and Move
_ Route/Network Building
_ Secret Unit Deployment
_ Set Collection
_ Simulation
_ Simultaneous Action Selection
_ Singing
_ Stock Holding
_ Storytelling
_ Tile Placement
_ Time Track
_ Trading
_ Trick-taking
_ Variable Phase Order
_ Variable Player Powers
_ Voting
_ Worker Placement
_ Acting

The gameplay connect behavioral elements - players and context - to one system. If there are no means for the players to produce input to the system, there will be no interaction and no game because games will not play by themselves. By choosing the right gameplay we can make motivate players to provide input in the game. This willingness to providing input is one interesting factor in resesearch process.

2.3 Artwork

Those two elements that we have mentioned earlier will be difficult to be optimized unless they are supported by appropriate artwork. artwork in the game plays an important role because of its ability to enhance the players experience during the game. The player experience is one important factor that we need to consider. Once a player feels that a game is providing interesting experience then she will be willing to play the game more than just once. This replayability factor is a direct result of optimizing three major elements that we discuss: theme, gameplay, and artwork. This replayability factor also an important aspect of learning and research because its define the iteration element that is necessary in almost every learning and research processes.
Another important factor of artwork in the game is its ability to provide simplified model of reality. Reality is amazingly complex and the only way our mind are able to get by at all is by simplifying reality so that we can make some sense of it. Correspondingly, our minds do not deal with reality itself, but instead with models of reality. With its ability in transforming reality into one simplified model we are able to deliver any kind of information with an effective way.

3 Reinforcement Learning Processes

Learning is the ability to absorb new information through our senses and process and store the useful bits to be used in future. Correct storage makes for proper memory. Intelligence is the ability to use this stored up information to reply correctly to any present situation. In order for a human being to learn well and act sensibly therefore the processes of obtaining information, sorting it out and storing it must be done effectively. Inspired by behaviorist psychology, in the area of machine learning in computer science, there are known two approaches in learning processes: supervised and reinforcement learning. In supervised learning an agent is taught how to respond to given situation, while in reinforcement learning the agent is not taught how to behave, rather it has a “free choice”in how to behave. However once it has taken its actions it is then told if its actions were good or bad (this is called the reward normally a positive reward indicates good behaviour and a negative reward bad behaviour) and has to learn from this how to behave in the future. However very rarely is an agent told directly after each action whether the action is good or bad. It is more usual for the agent to take several actions before receiving a reward. People usually have a reinforcement learning process when they learn to play board games for the first time. Although in the later process they learn using reasoning and analysis, in the beginning they learn by trial and error. they play the board game and rather than deducing that they have won because action X forced the opponent to make action Y, they learn that action X is correlated with winning and because of that they start to take that action more often. However if it turns out that using action X results in them losing games they will stop using it. That learning approach is similar with the approach that most of the children take when they learn to do many activities (i.e. walking, sports, etc.). Reinforcement learning process is indeed the earliest learning process that we known and it is proven as an effective way of learning.

4 Play, Learn, and Research

It has long been understood that play is, in itself, intrinsically self-motivating (Verenikina et al., 2003). Indeed, in the play of children the inherent attraction of play led many scholars to theorise its purpose as instinctive and functional. Not surprisingly, these early ideas were largely founded upon the physical play of young children who had an excess of energy that was not available to adults engaged in work activities. Subsequent theories have retained this important role of play in the psychological, cognitive, and social development of children. In discussing the propensity for play in human beings more generally, Johan Huizinga dismisses this emphasis on function, instead proposing that play, and more specifically higher forms of play such as the contest, operate in the realm of ritual (1950, pp.46-75). Huizinga argues that no benefit need necessarily be gained from play activities since they are entirely intrinsically motivating: “(Play) interpolates
itself as a temporary activity satisfying in itself and ending there.” In the seminal work Man, Play and Games, the sociologist Roger Caillois described all forms of play, including games, as being positioned on an axis between two extreme points: Paidia and Ludus. He described the concept of Paidia as “a primary power of improvisation and joy”compared to its polar opposite, Ludus, for play heavily defined by strict rules, which is defined by “a taste for gratuitous difficulty”.

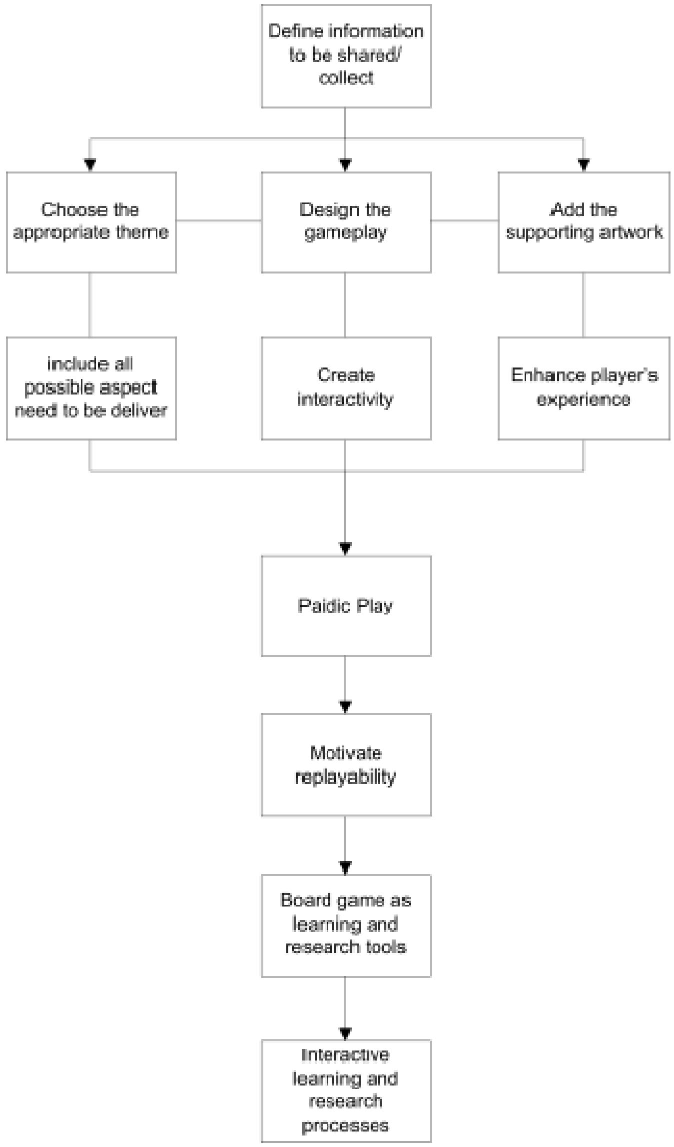
Every game conceptually sits at some point on the scale, depending on how much of the experience is driven by a formal system of rules. In the words of Caillois, “(Paidia) covers spontaneous manifestations of the play instinct: a cat in a ball of wool, a dog sniffing, and an infant laughing at rattle represent the first identifiably examples of this type of activity”

However, it is important to note that Paidia is not just found in games that are designed specifically to allow for this form of play. Just about every game supports paidic play in some form, but through design choices, some games support this style of play more explicitly.

Being able to design a game that support the paidic play is indeed one important condition for our purpose because it provide an environment for the players to explore their options in the game with the most flexibility. By doing that, they also being able to implement the reinforcement learning method in during the game.

These situation, where players has the most flexibility of exploring their options and where they able to implement reinforcement learning by their own choice is an optimal situation in any learning and research environment.

The following flow chart is providing step and method in optimizing board game enhance creative learning and research processes:



5 Conclusion

Board game has the ability to present a simplified models of real life problems. In board game, there is exist tried-and-tested methods for comparing the strengths of different players, different situation, different parameter, allowing for them to be used as a sample to compare and understand different approach to the problem. Moreover board game also provide high level interactivity which is necessary to transform any data collecting process to be fun and enjoyable. By optimizing three major elements in board game: theme, gameplay, and artwork we can transform board game into an effective learning and research tools. Because board game also relatively simple to design and relatively cheap in its production cost, the use board game to enhance the effectivity of learning and research processes in developing country should be an interesting option.

References

[1] World's oldest backgammon discovered in burnt city, April 2004.
[2] R. C. Bell. Board and Table Games From Many Civilizations. New York: Dover, 1979.
[3] R Caillois. Man, Play, and Games. New York: Free Press, 1958.
[4] A. Curry. Monopoly killer: Perfect german board game redefines genre.Wired, April, 60-72., 2009.
[5] Adriann Degroot. Thought and Choice in Chess. Mouton De Gruyter.
[6] M. Flanagan. Board Games. In Critical Play: Radical Game Design. Cambridge: MIT Press, 2009.
[7] J Huizinga. Homo Ludens: A Study of the Play Element in Culture. Boston: Beacon Press., 1950.
[8] A. Järvinen. GamesWithout Frontiers: Theories and Methods For Game Studies and Design. PhD thesis, University of Tampere, Tampere, 2007.
[9] Allen Newell and H. A. Simon. Human Problem Solving. Prentice Hall, 1972.
[10] Philip A. Orbanes. Monopoly: The World's Most Famous Game & How it Got that Way. Da Capo Press, 2006.
[11] John Von Neumann Oskar Morgenstern. Theory of Games and Economic Behavior. Princeton Univ. Press, 2007 Ed.
[12] Peter A. Piccione. In search of the meaning of senet. Archaeology, pages 55–58, July/Agustus 1980.
[13] Harris P. & Lysaght P Verenikina, I. Child´s play: Computer games, theories of play and children´s development. Paper presented at the Young Children and Learning Technologies. Selected papers from the International Federation for Information ProcessingWorking Group 3.5 Open Conference, Melbourne, 2003.

FELIZ DESERTO'S LOCAL INNOVATION SYSTEM: CHARACTERISING OR MISCHARACTERISING THE LOCAL HANDICRAFTS IN BRAZIL?

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Abstract

In Alagoas, a state sited in the Northeast region of Brazil, sugar-cane cultivation and tourism are convergent economic activities, despite to be grounded differently. If the sugar-cane industry is benefited by the climate conditions and the type of soil founded just on that region, the Alagoas' seacoast owns a high touristic attractiveness degree and, consequently, has become the mainly product demanded by this industry. The handicraft industry in this Brazilian state is highly connected to the tourism industry. In spite of this, there are several communities that don't just sell souvenirs, but keep on representing a cultural heritage incorporated since colonial times

This paper aims to analyse, from the perspective of innovation, the economic development of handcrafts in Feliz Deserto village, looking for elements that collaborate for the development of a Local Innovation System without mischaracterising the handicrafts essence. It contributes to share knowledge of concrete issues to foster technological innovation and economic growth for developing countries, such as Brazil. For this, it was necessary characterise the Local Innovation System in Feliz Deserto and comprehend its role to the development of innovations into the community researched.

This research is typified like qualitative, exploratory and descriptive. About method, it's a case study, according to Eisenhardt's (1989) assumptions. Non-structured interviews and non-participant observations were the data collection instruments.

As research findings, the present institutional arrangement around the artisan community of Feliz Deserto village was characterised as a Local Innovation System with high level of maturity, due to the high perception level that members have about the results of each partner's performance. It is also a positive factor the existence of a dynamic performance of the agents, consequence of development of productive and organisational skills of the community members. However, it was identified deficiencies in coordination efforts, and a lack of discussion and evaluation environment about what is being made by each LIS member.

With regard to mischaracterisation and authenticity, it was evident that the work developed by LIS members has contributed to authenticity legitimating, through the structuring of artisan production on three basic pillars: strengthening the raw material, linkage to the location and recovery profile of the community. Results of this structure are the creation and promotion of a local brand, their own value-added products and rewards such as prizes from national reputation entities of the sector.

Keywords: Local Innovation Systems, organisational innovation, Brazilian handicrafts, cultural heritage

Introduction

In the Brazilian northeastern state of Alagoas, regarding the territoriality of economic activities, tourism and sugar cane crops are convergent, although based on different grounds. While the sugar industry benefits from the climate and soil type found only in these regions, the seacoast has a high degree of attractiveness and, in essence, is the main product of attraction of tourist demand in that state.

This coincidence leads to a consequence of Alagoas economic context: the lack of tradition in other economic activities that may stand out as solid alternatives and justify a major project of social inclusion and the generation of employment and income. This situation mostly occurs due to land concentration for sugar production, and the consequent lack of tradition in other economic activities. If in the rural and backcountry areas, the activities related to agriculture and trade may stand out because of the experience of the local communities, in the seacoast areas and *Mata Atlântica* (coastal forest) areas of Alagoas, the same inferences are not allowed.

Considering the serious issues that must be solved, it is understood the need for effective promotion of solutions in the economic and social development fields. However, it is important to respect the peculiarities and potentialities of each region; otherwise there may be waste of time and resources in a scenario of widespread unemployment and poverty.

In this context, the strengthening of companies and other production units, as well as productive arrangements, is a very important element in developing the initiatives that aim at the socioeconomic development of the region. Thus, considering the production and marketing perspectives, covering all that, by any chance, is intended to offer to the consumer/end-user, the following research question arises: *Can a local innovation system contribute to the economic development of an artisan community without mischaracterising the essence of its products?*

This paper aims to analyse, from the perspective of innovation, the economic development of handicraft work in the village of Feliz Deserto (sited on the Southern seacoast of Alagoas), searching elements that support the development of a Local Innovation System. It is noteworthy that, in the context of the handicrafts in Feliz Deserto, the term Local Productive Arrangement (Lastres and Cassiolato, 2000) also can be applied, due to the fact that configures a territorial agglomeration of economic, political and social agents – focused on a specific set of economic activities – and involves the participation and interaction of various firms, from final goods and final services producers to raw materials and equipment suppliers, customers, among others, as well as professional associations and government organisations. However, this paper analyses the community of Feliz Deserto from the perspective of inclusion of innovations without the mischaracterisation of the handicraft. Therefore, the concept of Local Innovation System is more suitable to the context of this study. To this end, it was necessary to define the Local Innovation Systems in Feliz Deserto and understand its role in the development of innovations in the studied community.

1. Local Innovation System

Through the cooperation of local actors, such as state and city governments, representatives of corporate entities, professional associations and educational and research institutions, it is possible to better exploit potentialities, solve competitiveness problems and promote the development of innovations in the local context.

Sabato and Botana (1968) proposed the integration of science and technology in the development process, mainly focusing on the interaction of three key actors: government, industry and universities. This proposal is known as *Sabato's Triangle*.

The innovative performance of a country depends, to a large extent, on how these actors relate as elements of collective creation system and knowledge use, as well as the technologies used by these actors. These actors are: private firms, universities, public research institutions and the people engaged in these institutions. The interaction may take the form of joint research, personal exchanges, shared patent protection, purchase of equipment and a variety of other possibilities. There is not a single accepted definition for Local Innovation System (OECD, 2004).

Etzkowitz and Leydesdorff (2001) described the complex movement of interaction, involving change and evolution, using the image of the Triple Helix. In the Triple Helix system, companies are located in the centre of the interactions network, determining the speed and direction of the innovation processes and technological changes. Government, companies and universities are connected in a network and operate as agents of local development (Lahogue and Cunha, 2004).

Although they have been created based on existing interactions in one country, Innovation Systems may gain a local setting, which is known as Local Innovation System. Thus, it is understood by Local Innovation Systems “a set of distinct institutions which jointly and individually contribute to the development and dissemination of technologies” (Cassiolato and Lastres, 2000, p.247).

These institutions, as mentioned above, may be firms, educational institutions and/or research funding bodies or government entities, constituting the reference framework which will allow the government to propose and implement policies that aim to influence the innovation process (Cassiolato and Lastres, 2000).

Especially in countries such as Brazil, which present large territorial dimensions and inter-regional disparities, the importance of having consolidated Local Innovation Systems is noteworthy, in this case as instruments for promoting development. According to Vieira & Albuquerque, “the regional development approaches related to innovation, as well as national, talk about the need to develop institutional arrangements in order to take advantage of opportunity windows” (Vieira and Albuquerque, 2007, p.370).

Analysing this context more deeply, especially in the Northeast region of Brazil, there is a predominance of small businesses, which reinforces the importance of strengthening the Local Innovation Systems as a catalyst instrument for business growth. Initiatives, such as the mediation between companies and knowledge institutions, or even credit facilitation, as the example exposed by Vieira and Albuquerque in the passage that follows:

> [...] Investment in innovation may require state intervention, in order to provide a more favourable environment for its expansion, mainly because the small and medium-sized firms often find difficult access to credit and pay much for financial services (Vieira and Albuquerque, 2007, p.370).

In this way, from the reunion of local institutions it is possible to better exploit the potentialities and solve problems of competitiveness, contributing to the development of innovations and organizations in that specific location. Ferreira Jr. and Tonholo comment, on the section that follows, about the importance of Local Innovation System as the promoter of development, especially in areas with low economic and social development:

> The path for sustainable development passes imperatively through the Local Innovation System. In our view, this is the starting point for building a successful agenda aimed at improving social welfare or a local and sustainable community development. [...] In other words, a Local Innovation System has to contribute to the construction of systemically competitive environments [...], without ceasing to be an important part of local development policy in equating of issues such as the more equitable income distribution, rescue of the cultural vocations of that community and intertemporal preservation of the environment (Ferreira Jr. and Tonholo, 2001, p.178-179).

2. The Craftsmanship and the (mis)Characterisation of the Handmade Product

When the word handicraft is delivered, one immediately believes him/herself to be talking about an artistic, cultural, and often unique product. Not only in its essence, but also in its production process. Houaiss (2010) defines handicraft as "the art and technique of manual, non-industrialised labour, made by an artisan, and escaping mass production, has a time utilitarian and artistic end."

> The craftsmanship [...] represents a secondary and supplementary occupation for those who run it. The jobbers chain, moreover, that extends from the manufacturer to the customer, contributes to dilute the small profit of the artisan. The creator of wealth becomes, then, the one who enjoys it the least. To be compensatory from the economic point of view, handicraft production needs to become a market activity and no longer be just a mere subsistence activity (Vainsencher, 2007, p.5).

Add to the Vainsencher's explanation the fact that the trajectory of the artisan in the market (as the individual producer and marketer of his own products) often begins with the lack of opportunities in the labour market. Not all artisans have the handicraft as part of their life history, and make of this history a living. Nevertheless, it is estimated that in Brazil about 8.5 million people work with handicraft, generating sales of approximately 11.7 billion euros (Hoffmann 2006).

It is then that the most significant differential of handicrafts arises, in relation to other economic activities: the possibility of greater social inclusion, for it is easier to aggregate and qualify a large group called *unskilled*. Whether in regions where there is a reduced supply of jobs, or in those where there is insufficient qualification to occupy vacancies, the craftsperson ends up becoming an agent in the already significant informal market in Brazil.

This relationship among handicraft, culture and the informal economy is already being discussed in Brazil for quite some time, as Pannunzio (1982) has shown and described:

> Within the informal sector the artisan deserves special attention, with very special characteristics due to the close link between his productive activity and the cultural habitat and in which he/she lives. The artisan not only produces goods, he/she perpetuates manners and habits, preserving the culture of the environment in which he/she lives. Therefore, the value added by the craftsmanship, is not strictly economic, it has a strong socio-cultural component (Pannunzio, 1982, p.10).

Confirming the cultural and economic importance of handicrafts, Oliveira (2006) introduces handicrafts as a result of public development policies. For the author, handicrafts

> Has also been subject of research and interventions of political nature, promoted by government entities related to issues of cultural heritage **preservation** and **developmental** policies with the intention of maintaining the rural people in their area and the employment and income creation (Oliveira, 2006, p.40, highlights by the author).

As most artisans are individuals without professional qualification or with no knowledge of market structures, rare are the circumstances where one formally makes a living on handicrafts. Although there are artisans who could turn their names into a brand, and from then added value to their products, the most common situations are of Associations of craftsperson in the form of cooperatives or associations themselves, bringing together approximately 200,000 artisans throughout the country (Hoffmann, 2006).

These associations, in many cases, are responsible for marketing the product developed by each member, but can also be a joint effort to meet the market demands, or for higher added value of products from a particular community or region.

When it comes to structuring handicrafts as an economic activity, the mind is naturally leaded to the need for increased production scales and sales volumes. Thereafter, the profitability of those who make their livelihood from this activity would be generated. Considering this analytical perspective, the innovation would have the role of providing the necessary elements to improve the levels of competitiveness, increase profitability and help in the consolidation of the process.

There are countless cases, both in Brazil and abroad, of products which were originally designed as legitimate handicrafts connected to a certain culture, started to be produced in far superior quantities, and ended up losing their original characteristics. Thus, it is important to note, when discussing this issue, that the main fear of the market is the mischaracterisation of the handcrafted product, resulting in what is known as *industrycraft*: a set of products that have handcrafted features only in the production process, leaving aside the cultural elements that would make them unique, and that, somehow, are present on the concepts presented by different researchers on the subject (Mascêne, 2010).

3. Methodology

The most appropriate research to the objectives already defined and presented is qualitative, which Malhotra (2001, p.155) states as one that “provides better insight and understanding of the context of the problem.”

Consequently, the research can be classified as exploratory and descriptive. Still according to the author,

> [...] The purpose of the exploratory research is to explore a problem or situation to provide criteria and understanding. [...] it is characterised by flexibility and versatility with respect to the methods, for there is no application of protocols and formal research procedures. It rarely involves structured questionnaires, large samples and probability sampling plans. Instead, researchers are always alert to new ideas and data (Malhotra, 2001, p.106).

The method employed was the case study, defined by Eisenhardt (1989) as

> A research strategy which focuses on understanding the dynamics present within single settings. [...] combine data collection methods such as archives, interviews, questionnaires and observations. The evidence may be qualitative (e.g., words), quantitative (e.g., numbers), or both. [...] can be used to accomplish various aims: to provide description, test theory or generate theory (Eisenhardt, 1989, p.534-535).

The unit of analysis is the community belonging to the *Associação das Artesãs de Feliz Deserto* (Female Artisans Association of Feliz Deserto), created in the 1990s, and composed by native women, in majority old rural workers and housewives, now living from the manufacture of items with the Taboa straw (*Typha domingensis*). So, the members of this Association may be characterised as research subjects.

The data collection instruments used were the non-structured interview and observation. According to Marconi and Lakatos, the non-structured interview is appropriate because

> [...] the interviewer has the freedom to develop each situation in any direction as it sees fit. It’s a way to explore an issue more broadly. In general, the questions are open and can be answered in an informal conversation (Marconi and Lakatos, 2010, p.82).

As to a non-participant observation, it becomes appropriate in this study because, according to Marconi and Lakatos,

> Observation is a technique for collecting data to acquire information and uses the senses in obtaining certain aspects of reality. [...] The observation helps the researcher to identify and obtain evidence about the goals in which individuals are not aware, but that guide their behaviour (Marconi and Lakatos, 2010, p.76).

The interviews made have been transcribed and the remarks recorded on forms and reports. Therefore, a critical analysis of the processes described was performed, as well as the interpretation of the information provided by interviews, in light of the theoretical approach developed for the study. It is noteworthy that the study has a qualitative trait and is not aimed to any kind of generalisation for other artisans' communities.

4. The Feliz Deserto's Local Innovation System

The observation of the institutional arrangement that orbits the Female Artisans Association of Feliz Deserto resulted in the finding that, more than mere welfare features, contributions from partners to the Association have as main goal the promotion of the emancipation of the group, through the development of their productive skills and organisational competences. Hence, presented in this section are, not only the characterisation of what was identified as an Innovation System of local nature, or Local Innovation System (LIS), but also the profile analysis of the partners relationship, the role of each one in the development of these skills and competencies, and the already perceived main consequences of these actions over this arrangement within the community.

In order to make a first presentation of the institutions that are part of the Feliz Deserto's LIS, and start the discussion about the particularities of this arrangement, Figure 1 is shown below:

Figure 1: Members of the Feliz Deserto's Local Innovation System

When characterising the System, we can see a diversity in the profiles of the participating institutions, which is reflected in the pattern of relationships with the community and their own interests envisioned with the establishment of each partnership:

a) Brazilian Service of Support for Micro and Small Enterprises (SEBRAE): private non-profit entity that has as main objective the promotion of entrepreneurship, competitiveness and development of micro and small Brazilian firms. Its work is focused on consulting and education activities on the related topics. As autonomous social service, its main interest is the development of economic activities (including regional ones), measured from the number of new firms, whether companies or production entities, such as cooperatives and associations. In the specific case of Feliz Deserto, the Handicrafts' Department (And its Handicraft Program – PROART) was the main inducer of the creation of the Association, as well as the current structure of the LIS, developing intervention strategies and establishing the first articulations with the community and the other members;
b) Banco do Brasil: It is the largest public bank and also the largest financial institution in the country. In the state of Alagoas, it shares with Caixa Econômica Federal functions that are primarily attributed to the public banks, such as payment of social benefits, financing of productive activities and banking inclusion, besides the normal functions of a retail bank. At the branch located in the neighbouring city of Piaçabuçu, the associated women maintain the checking account of the Association, and also have registration and credit lines available for the financing of productive activity;
c) Feliz Deserto's City Hall: It is the government institution which is closest to the community and that, by its very nature, has as main objective the establishment of policies that result in the socioeconomic development of the population. Within this perspective, the development of the Association has been one of the main projects of employment and income generation of the city. With this support given to the Association, it was also noticed the return in terms of institutional visibility, both from the political point of view, and economic, from the increased tourism activity;
d) Usina Coruripe, Inc.: The company, a sugarcane plant, is part of the alcohol-sugarcane sector and the main employer in the region. Based in the city of Coruripe, it has direct and indirect influence over several surrounding cities, including Feliz Deserto. Holder of ISO 14001 certification, believes that, within its policy of corporate social responsibility, the interaction with local communities is a positive factor for environmental preservation areas that are part of its Private Natural Heritage Reserve (RPPN).

Regarding the role that each of these institutions plays in the community, Lucas Jr., Dantas and Milito introduce, briefly:

> Since 1999, with the creation of the Handicraft Program (ProArt) as part of SEBRAE-AL, the artisan community has received constant training regarding the association activism principles, design, and the marketing and pricing techniques. The Feliz Deserto City Hall yielded the physical structure where the Association is currently run and pays for part of the transportation in some orders. And Usina Coruripe, Inc., not only performs orders for products that are part of its institutional advertising, but also finances the participation of the artisans in fairs and exhibitions (Lucas Jr. *et. al*., 2005, p.6).

Note that, at this first moment, there are still no references to Banco do Brasil's role, due to the fact, confirmed by the representatives interviewed, that the institution was not part of the arrangement. Currently, the Bank is the depositary of the Association's checking account and keeps pre-approved credit lines at the disposal of the associates, for whenever there is a need for funding of the productive activity.

Comparing previous records with the current reality of the Association and its partners, it was found that the role of members of the LIS did not change over time. However, there were significant changes in the level of importance that was then assigned to each institution. With the development of the productive skills and organisational competences of the associated women, old requirements (assigned to certain partners) are no longer a priority; giving way to others, whose competence to meet their needs has been historically assigned to a different member of the LIS.

This process of accumulating experience from the social context is not only positive in general, but it is also considered an important element, not only for the consolidation of LIS as a whole, but for the innovations themselves. For Santos, it is the set of

> [...] experiences and skills embodied by individuals and organisations as well as skills and habits [that] would give birth to a context, [...] [and that] are central to the existence and the nature of the innovation process (Santos, 2008, p.145).

In Feliz Deserto, an example that shows some of the consequences of the institutions experience gain in the reconfiguration of the LIS is the diminishing role that SEBRAE has played over time. At the start of the Association, the institution was largely responsible for the mobilisation of the artisan community, as well as structuring the institutional arrangement that generated the LIS. Currently, the institution has acted in the activities of the Association on an occasional fashion, as in preparation for the participation in fairs and events, or renewing the Association's portfolio.

On the other hand, Usina Coruripe, Inc. and the Feliz Deserto City Hall took on more responsibilities, and are much more present in the daily life of the community. A factor justified not only by the profile of assignments granted (the maintenance of the physical structure and the aid in routine activities, such as orders transportation), but also by geographical proximity (the headquarters of SEBRAE is in the Alagoas state capital, Maceió, Banco do Brasil is in the city of Piaçabuçu) and institutional (the community was included on the list served by the social responsibility activities of Usina Coruripe, Inc.). The enterprise also has an important role as a corporate customer of the products from the Association, according to the following statement:

> We have just had a seminar from STAB, who came here, here to Usina Coruripe, Inc., 500 people. So our postcard, when you came to get your briefcase, your purse, we gave priority to what? To Taboa and Ouricuri[i]. So every visitor there got what? A briefcase, a purse, right? In that bag there was a brochure, in that bag there was a T-shirt, disclosing all this work (Testimony provided by Valdir Gomes, environmental management system coordinator at Usina Coruripe, Inc., at the company headquarters in January 2009).

Observing the context from the perspective of interaction among members of the LIS, it was found that the ties that bind them may be considered weak. According to testimonies gathered, there is not a forum established, formally or informally, under which there may be a dialogue about the work that is being developed, and not even an assessment of these actions. Again, geographical and institutional proximities are crucial factors in the strength of the ties, which results in increased interaction between the City Hall of Feliz Deserto and Coruripe's Plant. Situation ratified by the following testimony:

> Periodically, there are no [meetings between members of the LIS]. There are meetings when they are needed, you know? When in need, we're gathering, especially with Usina Coruripe, Inc., right? And SEBRAE ... usually they form a more collective meeting, right? With other cities too, so that we're always participating ... But with respect to specific support, like, to Taboa's handicraft, we're more involved, like, with the Usina, right? We have, like, a more open dialogue with the Usina, more interaction with Usina Coruripe, Inc. (Testimony provided by José Hordgys, Secretary for Tourism of Feliz Deserto, at the Secretariat, in January 2009).

Despite this apparent weakness of the ties in the LIS, the funding for the Association participation in fairs and events – important activity in promoting and strengthening the brand of the community – is one of the points that still promotes the meeting among LIS members. None of the institutions is able to sustain the Association alone, a process that involves expenses such as travel, registration, and even the financing of the sample to be exposed. Besides, the disbursements for maintaining the infrastructure of the Association are still high, SEBRAE and Usina Coruripe, Inc. fund activities in other communities, and the City Hall suffers from the natural budget constraint.

In the following statement, the role of each in the participation process of the Association can be understood, in the context of enabling a fair or a business roundtable:

> Usually we go with the staff, to support the staff. So, for example, the City Hall gives airline tickets; SEBRAE solves something else there, and the enterprise pays for the largest part. [...] We do the following: we communicate the partners, saying, for example, "the cost of a fair is this: how much could you get, amounting to that much?" Then let's assume, if the fair costs BRL 30,000, that guy will not necessarily provide BRL 20,000, but he should at least sign in with something, right? You must sign in with something, the truth is this. The name's already saying: it is a "partner"! (Testimony provided by Valdir Gomes, coordinator of the environmental management system of Usina Coruripe, Inc., at the company headquarters, in January 2009).

Further exploring this apparent weakness of the ties between members of SLI, each was asked to analyse some aspects concerning the members of the LIS: a) the role played by all, and its relevance in the current context of the Association, b) the performance efficiency of each partner, and c) which of these partners would most be missed (or would cause negative impacts) should it withdraw its subsidies to the Association.

Deliberately, in order to allow freedom of thought, the possibility of self-assessment was included, and no response parameter was given. However, after reviewing the statements, three response patterns to the overall assessment outcome of each partner were defined: “very important”, “important” and “less important.”

The analytical result of the collected responses is shown, in a condensed way, in Table 1 below:

	Usina Coruripe, Inc.	**Feliz Deserto City Hall**	**SEBRAE**	**Banco do Brasil**
Usina Coruripe, Inc.	Very important	Important	Important	Less important
Feliz Deserto City Hall	Very important	Important	Important	Important
SEBRAE	Very important	Very important	Very important	Important
Banco do Brasil	Important	Very important	Important	Important
Interviews Trend	Very important	Very important / Important	Important ↑	Important ↓

Table 1: Mutual Perception of the LIS Members Importance

These data, arranged in an array where the rows show the opinion senders, and the columns show the opinion receptors, reveal a general trend in the assessment of each partner. Usina Coruripe, Inc., for example, which is considered "very important" by three of the four members of the LIS, presents a higher degree of perceived importance than Feliz Deserto City Hall, which oscillates between the concepts of "very important" and "important" (2 votes each).

So, based on the statements of interviewees, and taking into account the confrontation with the role that has been played by each institution in the current scenario of the Association, it was perceived that there is a clear difference in forces among each of the bonds, which is reliably reflected in the study of the mutual perception of importance. That analysis is strengthened with the verification done by the president of the Association herself, subjected to the same survey, the interviewee responded in line with other institutions. Table 2 presents, in condensed way, the analysis performed by the president of the Association.

	Usina Coruripe, Inc.	**Feliz Deserto City Hall**	**SEBRAE**	**Banco do Brasil**
Interviews Trend	Very important	Very important / Important	Important ↑	Important ↓
Association	Very important	Important	Important	Less important

Table 2: Perception of the LIS Members Importance, According to the Association

This coincidence in the perception of the LIS members importance shows that the level of maturity of the arrangement can be considered high, since that, even without the existence of discussion forums or evaluation meetings, every member is aware of the actions of others, and realise the results of each action in the context of the community. A discordant note in this aspect is Banco do Brasil, which presents a different perception about the balance of forces in the LIS: fact that is justified by its relatively recent entry in the system and the consequent lack of proximity to the other members. A lack that, in some cases, influenced the assessment made by the other institutions.

Thus, it is clear that, in the current configuration of the functional context and organisation of the Female Artisans Association of Feliz Deserto, Usina Coruripe, Inc. is the strongest member of the LIS, as a result of the leading role of their representatives within the community, the consequent response capability to the Association's demands and the coordination with other partners. Right after, appears the Feliz Deserto City Hall, the main government institution partner, great speaker and funder of the production and sales facilities and some routine activities of the community. Later there is SEBRAE, as responsible for the management and design consulting and that also helps in the participation in industry events. Ultimately there is Banco do Brasil, which has some operational activities, but which does not have a decisive role in the context of the community.

Another point worth mentioning is the positive result of the external induction process characterised by the action of the LIS members within the community. In a context marked by problems such as low levels of social organisation, illiteracy and lack of economic alternatives, the risks of success of such initiatives become much reduced, due to the deficiencies which are inherent in the community, and also due to the misunderstandings that can arise in the interpretation of the actual community needs by the external agents, and the resulting disconnection between the actions planned and the established social reality.

In the case of Feliz Deserto, the following factors contributed to the success of the initiative:

a) The correct identification of the community demands and potentials, as the result of a continuous dialogue between the inducing agents and the people who would then form the Association, and with the Association, after it was established;
b) The identification of the institutions which best contributed to the induction process and with the maintenance of the structure once deployed, as well as the correct articulation aimed at the assembly of the institutional arrangement and the definition of their roles in the process; and
c) The clear commitment of the LIS member institutions in the establishment of a process that, even long-term, provides the Association the necessary conditions for its self-sustainability, ending the role of the System.

Therefore, observing the results of this study, it was understood that, in initiatives such as the Feliz Deserto's Local Innovation System, the predominant factor for success is the configuration of the arrangement, even more than the existence of a strong connection among members when it is already constituted. Such a configuration, as the result of the proper functions distribution of each member, according to their potentialities and comply with their peculiarities.

4.1 Influence of the LIS in the Authenticity of the Local Handicraft

One of the most significant impacts of the LIS performance on the Female Artisans Association of Feliz Deserto has been the change in the handicrafts profile of the locality. In a little over 10 years of the Association existence, handicraft production no longer has a limited capacity and low quality. The organisation of artisans as a community and the constant improvement of the production process and design led to the development of new products and a significant increase of production capacity.

It is a fact that these consequences could have substantially affected the essence of the handicraft production, thus ultimately leading to a mischaracterisation of local handicrafts. But the reality presented in this study has shown that the variables "increase in the productive capability" and "distortion level" are not directly proportional. The work of promoting the production organisation was strongly linked to the strengthening of local handicrafts authenticity, and is structured in three basic pillars:

a) *Consolidation of the raw material* (Taboa straw), through the development of new products compatible with the Association's production process, confirming the versatility of the raw material; creation of the label *Artesanato da Taboa* (Taboa Handicraft), which contributed to higher valuation of the product , and promotion of the adoption of sustainable management practices that ensure the supply along the year and in sufficient quantity to the increasing demand;
b) *Binding to the location* (Feliz Deserto), since the city has a strong tradition of customs and habits inherited from the indigenous inhabitants of the region, besides being the only region that features plenty of this raw material; and
c) *Appreciation of the community profile* (associated artisans), through the strengthening of associations and the positive impacts that this form of organisation has brought to the community over time.

The result of this action, which began with the consultancy of SEBRAE and was perpetuated by the monitoring of Usina Coruripe, Inc. and Feliz Deserto City Hall, was a greater awareness of the artisans about their role in the preservation of local cultural values, and the consequences of this awareness in the structuring of the economic activity, particularly with regard to branding and consequently aggregation of value to products. These factors necessarily imply increasing the authenticity of the handicraft, for reasons already discussed in previous sections of this paper.

An example of a positive result of this process of strengthening the authenticity lies in the fact that the recognition of the product quality and constant design updates in the portfolio led the community to be awarded, for two consecutive years, on a national campaign developed by SEBRAE, which acknowledges the major artisan groups in the country.

Thus, it confirms the idea that the action has limited time and in the long run, the community will depend less on its partners, will keep encouraged to increase their production and value levels, and will serve as an example to other communities in the region and in other states.

5. Conclusion

The institutional arrangement around the artisan community of Feliz Deserto was characterised as a Local Innovation System with a high level of maturity, due to the high degree of perception that members have of the performance results of each partner (except for the financial institution). Also as a positive factor for this finding, the existence of a dynamic in the agents performance, light of the development of producing abilities and organisational skills of the associates. This dynamic is recognised by senior members of the LIS, and the artisan community itself. However, a deficiency in the efforts coordination was identified, due to lack of an assessment and discussion environment of what is being performed by each member. It should be noted the jarring assessment given by and for the financial institution, as a result of the lack of recognition of their role, both by the community and by the other LIS members, by the little experience in the arrangement and geographic and institutional distances.

About the forces dynamic of the LIS, it was found that there is a strong dependence on geographical proximity and on the ability of financial investment. This way, Usina Coruripe, Inc. is the strongest LIS member, the Feliz Deserto City Hall occupies the second position in order of strength, followed by SEBRAE and Banco do Brasil. It is noticeable that the role of SEBRAE used to be bigger, and that this decrease occurred in a deliberate fashion over time, result of the artisan community development and maturation of the institutional arrangement itself.

Regarding the discussions on mischaracterisation and authenticity, it was evident that, despite changes in the production profile and growth in productivity levels, the work of the LIS cooperated with the strengthening of authenticity, through the structuring of handicraft production in three basic pillars: consolidation of raw material, binding to the location and valuation of the community profile. Results of this structure are the creation and strengthening of a local label (brand), their own aggregation of products value and recognition of the Association in awards of national reputation in the industry.

As for the future of the community, it can be seen that in the long run, it will depend less and less on subsidies provided by the institutional arrangement. But, still weigh negatively to reach this objective, both the socioeconomic profile of the artisans (most do not have basic levels of education) and the lack of organisational skills that allow an interaction with other productive actors and the identification of business opportunities and market trends.

Notes

* In geographic terms, this may mean setting the coverage of one or more towns, a metropolitan region or area of influence, or even a state. In all cases, the pursuit of their specificities and vocations, and the consequent focus on developing innovations should be emphasised.

* Set of rules that establish the basic guidelines for developing a system to manage environmental issues within the company, or in other words, an environmental management system (Wikipedia, 2011).

* This is the National Congress of the Brazilian Sugar and Ethanol Technicians Society in the city of Maceió, in November 2008.

* Type of straw with which the artisans in the city of Coruripe develop their handicrafts. This community is also part of the list of projects assisted by Usina Coruripe, Inc.

* This is the Award SEBRAE TOP 100 Handicraft, which aims to recognise and value the work done by artisans throughout the country, selecting the 100 most competitive production units in Brazil (Feliz Deserto, 2010).

References

Cassiolato, J. E. and Lastres, H. M. M. (2000), Sistemas de inovação: políticas e perspectivas. *Parcerias Estratégicas,* Brazilian Ministry for Science and Technology, Brasília.

Eisenhardt, K. M. (1989), Building theories from case study research, *The Academy of Management Review*, 14, 4, 532-550.

Etzkowitz, H. and Leydersdoff, L. (2001) *Universities and the global knowledge economy*, Continuum, London.

Feliz Deserto, Prefeitura Municipal de. (2010) Rico artesanato de Feliz Deserto encerra Artnor com sucesso. Portal da Prefeitura Municipal de Feliz Deserto/AL. **Electronic edition available at** <http://www.felizdeserto.al.gov.br/portal1/municipio/noticia.asp?iIdMun=100127030&iIdNoticia=153347> Last acess in 12 feb 2011.

Ferreira Jr., R. R. and Tonholo, J. (2001), O Sistema Local de Inovação de Alagoas: potencialidades e fragilidades, in.: Tonholo, J. (Ed.) *Gestão em ciência e tecnologia: textos alagoanos*, EDUFAL, Maceió.

Hoffmann, G. (2006) Brasil quer exportar mais artesanato para o mercado alemão, *Deutsche Welle,* Electronic edition available at <http://www.dw-world.de>. Last acess in 20 jan 2010.

Houaiss, A. (2010), *Dicionário Houaiss da língua portuguesa,* Objetiva, Rio de Janeiro. Electronic edition available at <http://houaiss.uol.com.br/busca.jhtm> last access in 08 jul 2010.

ISO 14000 (2011), in.: WIKIPEDIA, the free encylopaedia, Wikimedia Foundation, Florida/USA. Electronic edition available at <<http://pt.wikipedia.org/wiki/ISO_14000>> last access in 11 feb 2011.

Lahorgue, M. A. and Cunha, N. C. V. (2004) Introduction of innovations in the industrial structure of a developing region: the case of the Porto Alegre Technopole HomeBrokers Project, *International Journal of Technology Management & Sustainable Development,* 2, 3, 191-204.

Lastres, H. M. M. and Cassiolato, J. (2000), *Glossário de Arranjos Produtivos e Inovativos,* SEBRAE (Brazilian Service of Support for Micro and Small Enterprises), Rio de Janeiro.

Lucas Jr., D., Dantas, A. B. and Milito, C. M. (2005) Dos núcleos empreendedores artesanais de Alagoas para a União Européia: exportar é possível? *Proceedings of Encontro Anual da Associação Nacional dos Cursos de Graduação em Administração*, Belo Horizonte.

Malhotra, N. (2001) *Pesquisa de marketing: uma orientação aplicada.* 3 ed., Bookman, Porto Alegre.

Marconi, M. A. and Lakatos, E. M. (2010), *Técnicas de pesquisa: planejamento e execução de pesquisas, amostragens e técnicas de pesquisa, elaboração, análise e interpretação de dados,* 7 ed, Atlas, São Paulo.

Mascêne, D. C. (Ed.) (2010) *Termo de referência: atuação do SEBRAE no artesanato,* SEBRAE, Brasília. Electronic edition available in <http://www.sebrae.com.br/integra_documento?documento=4762969DAC2E2FBC8325770E005416FC> Last access in 19 jan 2011.

Oliveira, M. L. G. (2006), *Bordado como assinatura: tradição e inovação do artesanato na comunidade de Barateiro – Itapajé/CE,* Master's degree dissertation. Departamento de Artes e Design da Pontifícia Universidade Católica do Rio de Janeiro (PUC-Rio), Rio de Janeiro.

ORGANISATION FOR ECONOMIC COOPERATION AND DEVELOPMENT (OECD) (2004), *Manual de Oslo: proposta de diretrizes para a coleta e interpretação de dados inovação tecnológica,* FINEP/OCDE, Brasília. Electronic edition available at <http://www.finep.gov.br/imprensa/sala_imprensa/manual_de_oslo.pdf>. Last access in 24 jul 2008.

Pannunzio, P. M. (1982), *Aspectos do comportamento do consumidor de artesanato brasileiro – um estudo comparativo entre dois mercados,* Master's degree dissertation. Faculdade de Economia, Administração e Contabilidade da Universidade de São Paulo (FEA-USP), São Paulo.

Sabato, J. and Botana, N. (1968) La ciencia y la tecnologia en el desarrollo future de America Latina, in: *Proceedings of The World Order Models Conference*, Bellagio, Italy.

Santos, U. P. (2008) Uma classificação dos municípios de Minas Gerais segundo o grau de avanço de seus sistemas de inovação, *Revista de Desenvolvimento Econômico,* 10, 18. Universidade de Salvador, Salvador. Electronic edition available at <http://www.revistas.unifacs.br/index.php/rde/article/view/1047> Last access in 11 fev 2011

Vainsencher, S. A. (2010), Artesanato do Nordeste do Brasil, Pesquisa Escolar On-Line, Fundação Joaquim Nabuco, Recife. Available at: <http://www.fundaj.gov.br>. Last access in 20 jan 2010.

Vieira, K. P. and Albuquerque, E. M. (2007) O financiamento às atividades inovativas na região nordeste: uma análise descritiva a partir dos dados da Pintec. *Proceedings of Encontro Regional de Economia do Nordeste*, Fortaleza. Electronic edition available at <http://www.bnb.gov.br/projwebren/Exec/artigoRenPDF.aspx?cd_artigo_ren=1044> Last access in 08 jul 2008.

Promoting Value Co-creation Process within Garut Leather Jackets Industrial Cluster using Agent-Based Modeling and Simulation Methodology

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Abstract
Leather small industries in Garut, West Java, have made Indonesia one of the world major leather exporting countries. Its products from wallets up until sofa are not only popular in the country but also in foreign countries. Industrial clusters are generally defined as, spatial agglomerations of companies from related industry branches and, chains of production and value-adding. Within an industrial cluster value co-creation process involving resource and knowledge exchange continuously occur among service system. The proposed methodology combines qualitative, quantitative research, computer simulation and virtual experiments to formalize the non-linear interaction among heterogeneous agents within industrial cluster.

Keywords: Agent-based simulation, service science, system science, industrial cluster, Garut Leather Jacket

1. Introduction
1.1 Background

Service can be considered as a value co-creation, which is widely defined as a useful changes generated by purposeful and knowledge-intensive interactions between distinct entities (Spohrer & Maglio, 2008). Therefore, Service Science, Management, and Engineering (SSME) can be defined as a multi-disciplinary approach to study, improve, create and innovate the value co-creation process (Spohrer & Maglio, 2008; Spohrer & Maglio, 2010). As a new emerging field, research methodology in the SSME is still recently under development.

Leather small industries in Sukaregang village, Garut city, West Java, have made Indonesia one of the world major leather exporting countries. Its products such as wallets, bags, shoes, jacket, up until the sofa is not only popular in the country but also in foreign countries but most of the consumer is only from Indonesia especially Garut.

Ready-made leather jacket is one of Garut Regency's leather commodities, which are commonly called as 'Garut Leather Jacket'. The availability of raw materials is a supporting factor for the establishment of leather industrial district in Garut. Garut Regency provides abundant raw materials both from local and outer province. It is also a strategic location because it is adjacent with center of small leather industry tannery. Garut is geographically close to Bandung as the center of fashion industry and Jakarta as the national center of trade. This makes leather jacket production can seriously be increased because the leather jackets are marketable. According to Garut Government data in the year of 2008, the numbers of leather-wear clothes industry in Garut Regency are 417 formal business units, with more or less than 2953 to absorb labor. The amount of leather jacket production per year is about 200,000 pieces. The increasing demands for leather jacket from the outside of Garut Regency, such as Bandung, Jakarta, and several cities in Central Java, East Java, Bali and Sumatra have encouraged the growth of leather jacket craftsmen in Garut Regency.

Leather Jacket Garut also has the international market, such as Singapore, Malaysia, Taiwan, Japan, and Australia. Last data, Garut Leather Jacket exported to Singapore, Malaysia, Taiwan and Australia with a volume of 9488 reached $ 448,464 worth of cut (The Government of Garut Regency, 2011).

1.2 Objective

This study aims to propose an agent-based modeling and simulation research methodology, to facilitate multi-disciplinary approach in SSME researches. This paper not only outlines the relationship between SSME and agent-based modeling and simulation, but also steps in agent-based modeling and simulation research methodology. To give better understanding on the proposed methodology, an agent-based model of Garut's Leather Jacket industrial cluster case is intensely discussed. Within this industrial cluster service process occurs in the form of knowledge sharing in order to increase number of sales and costumer's satisfaction. By using the proposed methodology it is possible to combines both qualitative and quantitative research as well as computer simulation and virtual experiments to formalize the interaction among agents within industrial cluster. The further implication expected by this research is to produce policies in improving better knowledge transfer thus the Garut Leather Jacket's Business improvement will be achieved, includes also the business ethics conduct. Hopefully it will generate simultaneous value added process in this industrial cluster.

2. Theoretical Backgrounds

This section discusses the theoretical foundation used in this study. The discussion in this section is organized into three sub-sections. The first sub-section discusses the relationship and role of knowledge sharing process and service science, management and engineering (SSME). The second sub-section discusses the relationship between SSME and industrial clusters. Finally, the third sub-section discusses the relationship between complexity and SSME, and why agent-based modeling and simulation is a suitable methodology for studying SSME especially in industrial clusters.

2.1 The relationship between SSME and knowledge sharing

Service can be considered as value co-creation process, which is widely defined as a useful changes generated by purposeful and knowledge-intensive interactions between distinct entities (Spohrer & Maglio,2008). Therefore, Service Science, Management, and Engineering (SSME) can be defined as a multi-disciplinary approach to study, to improve, to create and innovate the value co-creation process (Spohrer & Maglio, 2008; Spohrer & Maglio, 2010).

There are several reasons for co-creation process implementation, *i.e.* (1) Both in individual or groups, people are always interested to be co-creators or co-creation process participant because human being should be adaptable to change to survive in the form of knowledge improvement; (2) Co-creation delivers value. It provides certain approach to repeated interaction with consumers. The transformative properties of co-creation are important input for improvement.

In studying the SSME, the service dominant logic is a framework that is considered to be appropriate (Spohrer & Maglio, 2010). There are five constructs in the service dominant logic that is, (1) service, (2) value, (3) system, (4) interaction and (5) resources (Lusch, Vargo, & Wessels,2005; Lusch & Vargo, 2008). The description of each construct is as follows:

- **Service:** In service dominant logic, service is defined as a relationship and interaction among service system in order to provide benefit for one another. As service system become more interdependent, relationship emerge and the potential of collaboration among service system increase (Vargo, Lusch, & Akaka, 2010). Based on the field study in Garut, the owners of a leather jacket outlet are to meet the needs of buyers by providing easy access to shops, the availability of a leather jacket with a design that fit the buyer, as well as affordable prices. The outlet owners also benefited by gaining profit in line with their expectations. The craftsmen meet the needs of the outlet owners to produce quality leather suit to jacket outlet owners or particular buyers.
- **Value:** In service dominant logic, value is defined as improvement in a system, as judges by the system or the system ability to fit an environment (Vargo, Maglio, & Akaka, 2008). Based on SSME perspective, value co-creation is the purpose and driver of interaction (Spohrer, Vargo, Caswell, & Maglio, 2008). Value co-creation process is not limited to the activities or resources of individual exchange occurrence, but also derived through the assimilation of existing and new knowledge (Vargo, Lusch, & Akaka, 2010). As the example, based on the field study, Garut Leather Jacket Stakeholders recognize the importance of upgrading skills of the craftsmen jacket to produce qualified products(the raw material selection, the jacket design and pattern, and the seaming). Given to the craftsmen limited level of education, some stakeholders (namely the outlet owner, the ranks of local government, and private agencies) have tried to organize several trainings which are expected to enhance the skills of the craftsmen. For the outlet owners who generally have private capital, training is carried out mostly in marketing and business development subjects, and held even up to foreign countries.

- **System:** A system is defined as a configuration of resources (resources is the terminology given for system components), in which the properties and behaviors of the configuration is more than the properties and behaviors of individual resources (Spohrer, Vargo, Caswell, & Maglio, 2008). The value co-creation is a complex process takes places in networks of relationships and resources (Vargo, Lusch, & Akaka, 2010).
- **Interaction:** Service dominant logic sees service as interdependent and interactive models that imply dynamics, non-equilibrium and non-deterministic relationships and models of exchange. This logic focuses on interactive and dynamic aspects of exchange, such as collaborative communication among service system and the learning that occur via exchange (Vargo, Lusch, & Akaka, 2010).
- **Resources:** Resources play important role in studying the relationship among service systems. In service dominant logic perspective, resources are not limited to physical entities. According to Maglio and Spohrer, entities within service systems exchange competence along at least four dimensions: information sharing, work sharing, risk sharing and goods sharing (Maglio & Spohrer, 2008).

As the example, the following figure illustrate the system, interaction, and resources application in Garut Leather Jacket industrial cluster. From the discussion in this sub-section it can be concluded that the knowledge sharing process has an important role in the study of SSME. Knowledge is one form of resources that can be exchanged between service systems; in addition, knowledge exchange is also a driver of the interaction and learning process between service systems that always occurs within the service network.

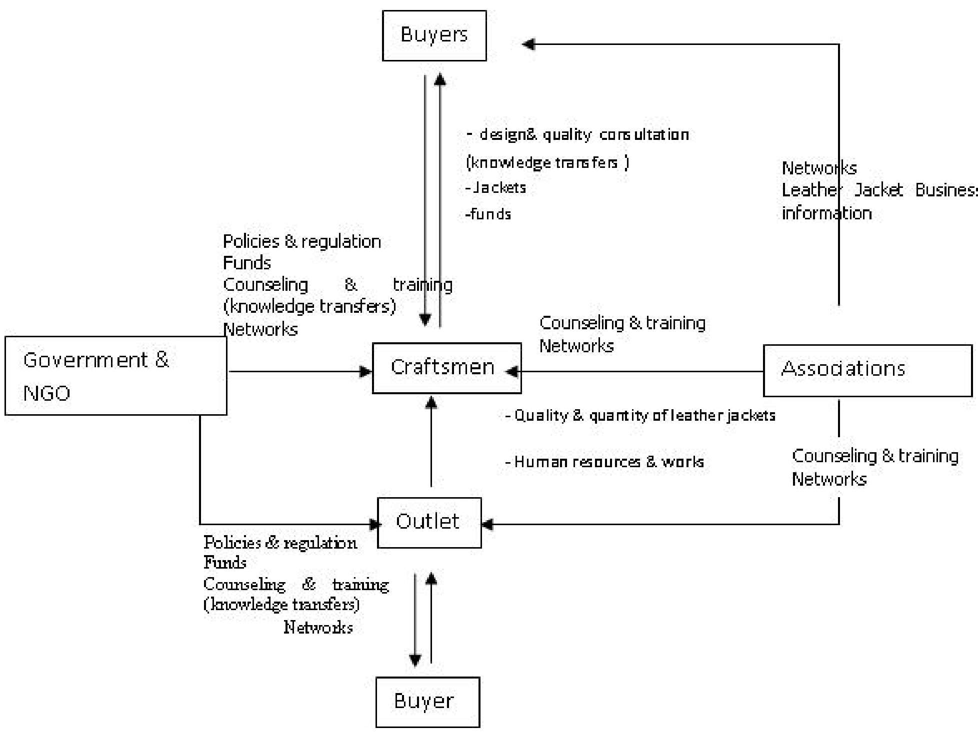


Fig. 1. Garut Leather Jackets Co-creation process

2.2 Relationship between industrial cluster and service science

Industrial clusters can be defined as spatial agglomerations of companies of related industry branches and chains of production and value-adding. In a cluster, industries branches, their individual companies and related institutions (e.g. Governmental, research organizations and NGOs) are linked to each other by close relationship to a certain use of resources or form of production, by spatial clustering and by high connectivity in terms of business and support activities. The goal of cluster concept is to support these industry branches and their companies in general by optimizing production and value-adding processes within and between different branches (e.g. improving productivity, innovation and marketing through increased communication and cooperation) (Mrosek, Assmann, Kies, Allen, & Schulte, 2010).

Based on literature review there are several types of cooperation within industrial cluster (Albino, Carbonara, & Giannoccaro, 2003). The first type of cooperation is the horizontal cooperation such as purchasing and offering groups that organize supply or demand together in order to achieve economy scale and to increase the contractual power. The second type of cooperation is the vertical cooperation such as technical collaboration arrangement between manufacturing firms and infrastructure suppliers. The third type of cooperation is the hybrid cooperation such as educational trainings, aims to improve the industrial cluster performance that are organized by consortium or trade association. These co-operations involve a group of independents firms that not only pursuing their own autonomous objectives but also try to collaborate to achieve common goal and improve their performance (Albino, Carbonara, & Giannoccaro, 2003).

Through the discussion in this section, it can be concluded that the industrial cluster is an area suitable to study by using the service dominant logic framework. This is because the industrial cluster is composed of relationships between independent firms. In these relationships exchange and learning process that aims to improve the performance of industrial clusters occur. In SSME perspective, these processes can be viewed as value co-creation processes.

2.3 Complexity of an industrial cluster and agent-based modeling and simulation

The characteristics of the phenomena that occur within Garut Leather Jacket industrial clusters shows the characteristics possessed by a complex adaptive system, namely, non linear interaction among heterogeneous agents, distributed control and information flow, diversity in behaviors, ability to learn and so on (Gilbert, 2004).

An Agent-based modeling and simulation can be defined as a simulation of a system that consists of a number of software individuals, called agents. In this simulation, agents can interact with each other and with their environment (Gilbert, 2004), with specific rules. In dealing with a complex system, just like in industrial cluster, computer simulation can help because, there are several natures of computer simulation that ease us in building a model of a complex system, namely (Schmid, 2005) *i.e.* (1) Using computer simulation, we can deal with parallel process without well defined order easily; (2) It is easier to build a model that involves heterogeneous agents using computer simulation; (3) The modularity of computer simulation enables us to modify our model easily; (4) It is possible to model bounded rational agents; (5)It is easier to model turbulence social condition especially, when agent’s identities and attributes are unfix; (6) The nature of programming language that is more expressive than verbal language and less abstract than mathematical equation, enable researcher to model both quantitative and qualitative theories.

Therefore, agent based simulation can facilitate the collaboration among disciplines, this nature is very appropriate to fulfill the multidisciplinary approach requirement of SSME. Thus, it can be concluded that the Agent-based modeling and simulation is a methodology that is suitable to be used in SSME research, especially in industrial clusters.

3. Methodologies

This section discusses the agent-based modeling and simulation methodology used in this study. This methodology builds upon the agents-based modeling and simulation research methodology that is commonly used, but adapted to facilitate the paradigm SSME research, especially the service dominant logic framework.

The first step in agent-based research methodology is to identify the phenomenon that we want to understand better clearly (Gilbert, 2008). To accommodate the service dominant logic, the researcher must identify and try to answer the following questions:

- **Service:** Who are the actors involved in the service system being studied? What is the position and status of each actor in the service system being investigated? What are the tasks performed by each actor?
- **Value:** What parameters that can characterize the performance of the service system being studied? How to operationalize these parameters?
- **System:** How is the relationship among actors? What is the role of each actor to other actors?
- **Resources:** What are the attributes possessed by each actor? Whether the attributes possessed by each actor are fixed or dynamic? What are the factors that influence the attributes of each actor?
- **Interaction:** How does each actor behave? What decisions can be taken by each actor? How does an actor's decision may affect the attributes and decision of other actors?

In identifying the service system being studied, collecting a sufficient body of theory is very important. Like in other agent-based modeling and simulation research, theory about the dynamics and process about social phenomena are better than static or equilibrium relationship (Gilbert, 2004). By the way, any theories are better than none.

The second step of agent-based research methodology is to define the scope of the model. In this process, researchers need to specify clearly all assumptions that will be used in the model. The model can be started from a simple model that is easy to implement (Gilbert, 2008).

The next step is to begin the simulation design. In this step, the types of objects in the simulation are de-fined. Usually, there will be two types of objects in the simulation namely, agents and environment. If, one object consists of several sub-objects, then these objects must be arranged into a hierarchical class (Gilbert, 2004). After that, the attributes for all objects must be specified. An attribute is a characteristic or feature of an object (Gilbert, 2004). An attribute can serve as object's identity or, varies over time.

The fourth step is to design interactions among objects. A list all possible actions that can be carried out by each object is created (Gilbert, 2004). Then, rules that are used by an object to execute each action must be specified.

The fifth step is to validate the model. There are two steps of validation in agent-based simulation namely, internal validation and external validation. There are two processes in the internal validation steps first, is the conceptual validity check and second, verification process. Model validity determines whether the model is appropriate to serve its purpose or not (this parameter has yes or no decision value). While, verification process aims to getting rid of bugs (Schmid, 2005). During the external validation process, model's accuracy is tested. Model accuracy determines how close the model can reflect the reality (sometimes it can be measured from 0% to 100%).

The last step is to conduct virtual experiment in order to generate some hypotheses or explore the dynamic of service system. To conduct a good virtual experiment, proper experimental design should be followed. At first the core variables or parameters that are assumed to be the most relevant variables affecting the emergence properties must be identified. After that, the range of core variables values that are going to be explored must be defined. The noncore variables can be set according to the real world data (if available) or as random numbers. Then, we should run the simulation multiple times for each experiment set. Ideally we could obtain much larger data than that can be obtained in real world experiment. Finally, conduct the analysis for the simulation result.

4. Case Study: Agent-Based Simulation of Knowledge Sharing Process in Garut's Leather Jacket Industrial Cluster

4.1 Case introduction

Figure 2 illustrates the relationship of Industrial Clusters in leather Jacket Sukaregang, Garut. Each entity is linked to each other in the same area, which utilizes the same production resources and services in the form of live stock hides (especially cattle, sheep, and goats). Their relationships in the chain productions also provide value adding and carry out continuously in the form of business and support activities.

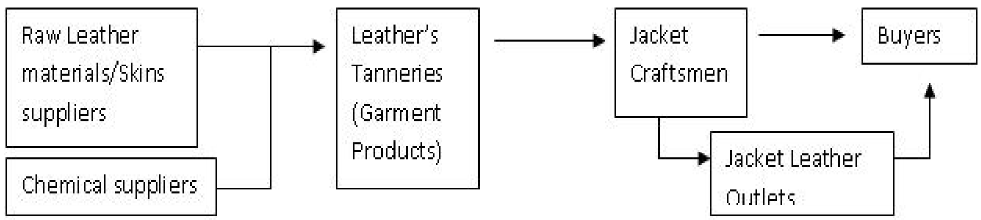


Fig. 2. Garut Leather Jacket Industrial Cluster

Raw Leathers/hides suppliers from Garut are difficult to meet the needs of Leather's Tanneries due to the lack of supply of raw materials. It becomes a major obstacle supply of leather Jacket products. Since the government issued regulations ban the import of raw materials in 1998 hides, leather suppliers complain of shortages of raw materials each year. Imports of raw materials leather constrained government regulations which only allow imports from countries that are free Foot and Mouth Disease (FMD). Meanwhile, imports from countries not declared free of foot and mouth disease is stopped, such as Brunei Darussalam, Thailand, Vietnam, and Latin America. Thus the Tanner companies effort in Garut includes discovering new domestic supplies, mostly from West Java Region, including Sumedang, Bandung, Majalengka, Bogor and Tasikmalaya but not limited to Surabaya, Madura, Wonosobo, Sulawesi, Lampung, and Nusa Tenggara if required.

Garut Chemical Companies (specializing in leather tanning chemical) generally trade imported materials. The supplies of chemicals are 60% purchase from China, followed by Europe, Thailand, and Singapore. Dependence on import chemicals is very high because of the domestic chemical prices tend to be more expensive) (Industri Penyamakan Kulit Butuh Perhatian Pemerintah, 2011).

The Leather's Tanneries in Garut carry out processing hides into finished leather using tanning materials. In the tanning process, only non-collagen raw skins are able to conduct the reaction with substances tanner. Leathers are so very different from skins or hides in the nature of organoleptic, physical, or chemical term. Mostly Garut Tanner practice mineral materials processing, such as chrome tanning materials. The hides' tannery outputs are used for skin box, leather jackets, and suede leather. For the record, the leather tops manufacture of thick rawhide (buffalos and cows) skin should be thinned according to the desired thickness by splitting it into several sheets of skin by Splinting Machines. The top parts of the skin called the rajah (*nerf*), used to skin the best boss (garment product materials includes jacket). Parts of the skin underneath is called split, which can also be used as leather superiors, by being given "*artificial nerf*" printed with a press machine (Embossing machine), at the stage of final settlement. In addition the splits can also be used to leather insoles in, crackers leather ("dorokdok"), or wood glue.

Jacket craftsmen are native who particularly originated from the area around Sukaregang village, Garut. According to some sources, there are no special skills required to become a leather craftsman. Basically, persons with tailor skill can learn the techniques of sewing leather jacket. The difference only lies in the use of special sewing needle on the sewing machine and sewing skills. For large shops and manufactures, craftsmen are categorized by leather jackets process (separated into some important parts). On the other hand, small scales production of leather jacket made by one person due to the designing, patterning, cutting, and sewing process, to became the finished product. It took 2-3 days to produce one units of leather jacket.

Buyers generally have difficulty to access the location of the craftsmen who are located in rural areas. Buyers (mainly tourists) prefer to visit outlets around the city. These outlets generally are the craftsmen who have sufficient capital to manage showrooms. Current issues stand for the diminishing of Garut originated outlet owner. Mostly leather jacket outlet owner nowadays are leading to the entrepreneurs who originated from Sumatra region.

4.2 Implementation of the proposed methodology

This section illustrates how to implement the proposed methodology using a case study. The case studies discussed in this paper are the case of leather jacket industrial cluster located in Sukaregang, Garut, West Java. The purpose of this case study is to describe the service performed in the industrial cluster in order to increase the sales of leather jacket. Service processes are carried out through knowledge sharing among actors by exchanging technical capabilities and expectations of each actor.

The center of leather jacket in Garut is in Sukaregang. The most important material of leather jacket is sheep and cow's hide, which the farms are also in Garut. In every year, they can produce 37.000 pieces smooth leather jacket and 193.500 pieces „connecting‟ leather jacket. In knowledge sharing process in leather jacket industrial cluster, there are three actors who interact with each other. The first actor is leather jackets seller. Leather jacket sellers are generally businessmen who have many experiences in leather jackets industry. Sellers are the actors who have the capital, set designs and sells leather jacket to the buyers. In designing leather jackets sellers sometimes involves the buyer to determine the design. In the leather jacket production process, sellers conduct joint production with leather jacket craftsmen.

In the constructed simulation three types of agents are defined *i.e.* leather jacket sellers, buyers and leather jacket craftsmen. Leather jacket sellers are located in random coordinates of 30 x 30 grids. Leather jacket sellers have a number of products that will be sold to the buyer. Each seller can have ten types of products. Each product has a number of features that represent elements in a leather jacket such as, colors, materials, and design. The number of feature for each product is set as 10 features. Each feature has a trait, defined as possible value of a feature. The higher the value of a trait the higher production skills that are needed to make it and the higher the price of the final products. The maximum value of a trait is 10. The price of the final product is assumed as a sum trait of all features. Because each product has 10 features, the maximum price of the final products is 100. Products of a seller are composed as a 10 x 11 matrix. Each row of the matrix represents a product, column 1 to 10 of the matrix represent product features and the last column of the matrix represents the product price. At the beginning of the simulation the each elements of product matrix is assign randomly. Each buyer in the constructed simulation is equipped with buying power i.e. the maximum price that can be afforded. The buying power for each buyer is set as a random number from 10 (the minimum price) to 100 (the maxi-mum price). Each buyer is also equipped with expectation toward leather jacket product i.e. the trait of each leather jacket features they want. These attributes is composed as a list with first ten elements of the list represents buyer's expectation and the last element represents their buying power. At the beginning of the simulation the buying power and the buyer expectation is set as random. Each leather jacket craftsmen is equipped with production skill list. Production skill list is a list with 10 elements with each element represents craftsmen capability to produce the desired traits of a product feature. At the beginning of the simulation each elements of production skill list are assigned randomly.

Each iteration buyers are walked randomly on 30 x 30 grids. If there are two buyers on the same coordinates an interaction will occur. In this interaction, buyer i will check the buying power of buyer j. If the buying power of agent j is less than or equal to the buying power of agent i (means that buyer i can afford similar style with buyer j) then agent i will calculate the similarity of both buyers by summarizing the number of features with similar trait. The number of similar features is the divided by the number of features to get the exchange probability between both buyers. If the exchange probability is fulfilled, buyer i will select a random feature with different trait. Buyer i will then replace his/her traits value by trait of buyer j. For example, suppose the feature of buyer i is [1 2 3 1 4 5 2 6 9 1] and the feature of buyer j is [1 2 3 6 4 5 2 6 9 9], then the probability of buyer i to changes one of its trait with one trait of buyer j is 80%.

In each iteration, a buyer has probability to visit a random seller. At the seller location, the buyers see whether the visited seller has products which price is lower or equal to his/her buying power. The probability of a buyer to buy a product (buying probability) is determined by dividing the total number of features with similar trait between the avail-able products and buyer's expectation, by total features of a product. If the buying probability is fulfilled, the buyer will buy the given product, and the number of sales of the given product is increased by one. Each time a buyer comes to a seller, the seller will identify the buyer expectation (equal to the buyer's feature) with the probability of consumer involvement.

Buyer's expectation is stored in seller's memory as a i X 10 matrix. Each row of this matrix represents a buyer that come to seller's location and each column of this matrix indicates the buyer's expectation toward the trait of each leather jacket feature. Every 10 iterations the seller will take average value of each column of the matrix, the result is then stored in a list with 10 elements. This list is the defined as a new product and used to replace one of seller's products which have the lowest sales.

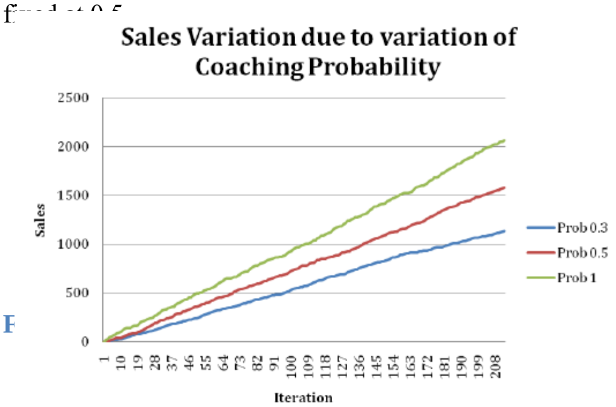
Each time a seller has a new product to develop, the given seller will gives order to a random craftsman. In this simulation, craftsmen are assumed to be always trying to fulfill the required specification given by the seller. But, since craftsmen have different production skill, the resulted traits may fall between craftsmen's production skill and the required specifications. Therefore, produced trait for each feature is determined as follows:

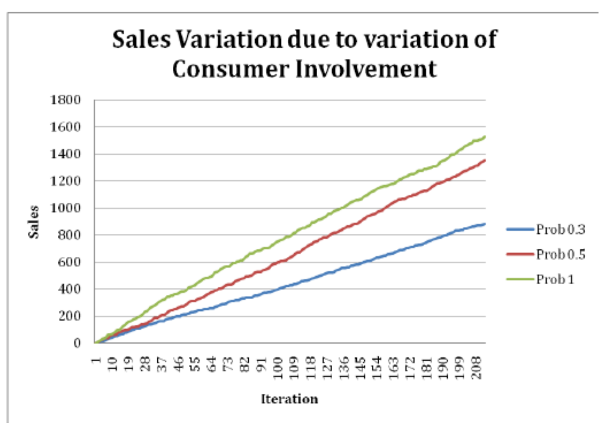
$$Pt_i = Ps_i + \text{random}\ (0, (Rt_i - Ps_i)) \qquad (1)$$

With probability of coaching probability, sellers can give coaching to the craftsmen that producing leather jackets forhim/her. The value of knowledge learned from sellers (learned knowledge) will depends on craftsmen's learning ability.

$$\Delta Ps_i = (\text{transmitted knowledge} - Ps_i) * \text{learning ability} \qquad (2)$$

The experiment process aims to test model sensitivity. These experiments are conducted to test the impact of probability to give coaching and the probability of consumer involvement, to the number of total sales. Using hypothetic data, the number of seller in these experiments is set as 5 the number of craftsmen is set as 20 and the number of buyers is set as200. In the first experiment the coaching probability is varied from 0.3 to 1 while the consumer involvement value is fixed at 0.5. In the second experiments the consumer involvement is varied from 0.3 to 1 while the coaching probability is fixed at 0.5.





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The simulation results show that the number of sales is sensitive to the variation of coaching probability and consumer involvement. The higher the value of coaching probability the higher the number of sales achieved. This result is conceptually acceptable because the craftsmen will be able to deliver products in accordance with buyer's expectations.

The second simulation results show that the higher the value of consumer involvement the higher the number of sales achieved. This result is also conceptually acceptable because the products that are sold by the sellers will be in accordance with buyer's expectations. Since the behavior of the constructed simulation model has been valid (at least conceptually), then this model can be developed further to study the Garut's leather jacket industrial cluster. Furthermore, this model can be used to generate scenarios and infer policies that can be implemented in Garut's leather jacket industrial cluster. Of course, for these purposes this model need to be calibrated by using data gathered from the real world.

5. Conclusions

This study has shown why the agent-based modeling and simulation is an appropriate methodology for the SSME researches, especially in industrial clusters. Agent-based modeling and simulation can help researchers to develop a model involving heterogeneous and autonomous agents, that are interrelated, have a dynamic attributes, and interact each other on an ongoing basis. These kinds of model specifications are the one want to be addressed by service dominant logic, which is the framework of the SSME. Through case study conducted in this study it can be concluded that, agent-based modeling and simulation can be used to model the interaction process that occurs within an industrial cluster. Although the experiments were conducted using a hypothetical data, but the behavior exhibited by the model that has been constructed are conceptually acceptable. For further research, the assumptions used in this model should be expanded so that the interactions that occur in the simulation become more realistic. In addition, this model also needs to be calibrated by using data collected from the real world.

References

Albino, V., Carbonara, N., & Giannoccaro, I. (2003). Coordination Mechanism Based on Cooperation and Competition within Indus-trial Districts: An Agent-Based Computational Approach. *Journal of Artificial Societies and Social Simulation* , 3.

Gilbert, N. (2008). *Agent-Based Models.* Los Angeles: SAGE Publications.

Gilbert, N. (2004, Desember 18). *Agent-based Social Simulation: Dealing With Complexity.* Retrieved Oktober 28, 2008, from http://www.agsm.unsw.eduau/bobm/teaching/SimSS/ABSS-dealingwithcomplexity-1-1.pdf

Industri Penyamakan Kulit Butuh Perhatian Pemerintah. (2011, May 19). Retrieved April 30, 2012, from www.businessnews.co.id: http://www.businessnews.co.id/featured/industri-penyamakan-kulit-butuh-perhatian-pemerintah.php

Lusch, R., & Vargo, S. (2008). The Service-Dominant Mindset. In B. Hefley, & W. Murphy, *Service Science, Management and Engineering Education for the 21st Century.* New York: Springer.

Lusch, R., Vargo, S., & Wessels, G. (2005). Toward a Conceptual Foundation for Service Science: Contributions from Service Do-minant Logic,. *IBM Systems Journal* , 5-14.

Maglio, P., & Spohrer, J. (2008). Fundamentals of Service Science. *Journal of the Academy of Marketing Science* , 18-20.

Mrosek, T., Assmann, M., Kies, U., Allen, U., & Schulte, A. (2010). A Framework for Stakeholder Analysis of Forest and Wood-Based Industry Clusters – Case Study at the State of North Rhine -Westphalia, Germany. *The Open Forest Science Journal* , 23-37.

Schmid, A. (2005). What is the truth of simulation? *Journal of Artificial Societies and Social Simulation , 8* (4).

Spohrer, J., & Maglio, P. (2010). Service Science: Toward a Smarter Planet. In W. Karwowski, & G. Salvendy, *Introduction to Service Engineering.* New York: Wiley & Sons.

Spohrer, J., & Maglio, P. (2008). The Emergence of Service Science: Toward Systematic Service Innovation to Accelerate Co-Creation of Value. *Production and Operation Management , 17*, 1-9.

Spohrer, J., Vargo, S., Caswell, N., & Maglio, P. (2008). The service System is The Basic Abstraction of Service Science. *41st An-nual HICSS Conference Proceedings.*

The Government of Garut Regency. (2011). *The Government of Garut Regency*. Retrieved December 31, 2011, from http://english.garutkab.go.id/pub/static_menu/detail/khas_pk_jaket

Vargo, S., Lusch, R., & Akaka, M. (2010). Advancing Service Science with Service-Dominant Logic: Clarification and Conceptual Development. In P. Maglio, C. Kieliszewski, & J. Spohrer, *Handbook of Service Science.* New York: Springer.

Vargo, S., Maglio, P., & Akaka, M. (2008). On Value and Value Co-Creation: A service System and Science Logic Perspective. *European Management Journal* , 145-152.

PRESERVING ANGKLUNG AS SUNDANESE CULTURAL HERITAGE THROUGH TRIPLE-HELIX COLLABORATION: A SAUNG ANGKLUNG UDJO'S EXPERIENCE

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Abstract
Nowadays, cultural heritage is more difficult to be preserved because of modernization effect. As key resource, cultural heritage has become a driver for development, which when properly managed can enhance the livability of their surrounding areas and sustain productivity in a changing global environment. The purpose of this paper is to expose triple-helix issues surrounding government, business, and academic institution in preserving cultural heritage and to raise potential concerns for local communities involved in cultural heritage tourism. The research was conducted at Saung Angklung Udjo as one of success story at implementing cultural heritage tourism as their core business. Case study is designed to show the performance accomplished by triple helix coordination in building cultural heritage. In-depth interviews were conducted to gather informations. The finding of this paper is conceptual model of triple helix collaboration in preserving cultural heritage. Preserving cultural heritage can be succeed through tourism business with collaborative management and coordination between business, government, and academic institution.

Keywords:triple helix ; cultural heritage ; tourism business ; angklung ; Saung Angklung Udjo

1. Introduction

Tourism is a world-wide giant industry which has a high increase rate such that UNWTO's Vision forecasts that international arrivals are expected to reach over 1.56 billion by the year 2020, which were 842 million in 2006 (World Tourism Organization). Cultural heritage tourism is also, increasingly being used as a tool to stimulate regional development in rural and urban areas (Gunlu *et al.*, 2008)

World's leading category of international trade, tourism, is increasingly offering a range of cultural heritage products, from visiting monuments to discovering unique ways of life as supply for increasing cultural and heritage tourism demand. UNESCO defines culture tourism as "to create a discerning type of tourism that takes account of other people's cultures" (UNESCO, 2005).

Ekwelem *et al.* (2011) noted that cultural heritage is based on the aspects of our past that we cherish, want to keep and pass on to future generations and outside world. However, the economic benefits of preservation are secondary to the intrinsic value of that heritage which is been preserved.

It is generally recognize that the 21st century will be a century of globalization. Notwithstanding all the benefits of economic globalization, it causes the substantive threat of cultural globalization (Grazuleviciute, 2006). Nowadays, cultural heritage is more difficult to be preserved because of modernization effect. As key resource, cultural heritage has become a driver for development, which when properly managed can enhance the livability of their surrounding areas and sustain productivity in a changing global environment. It is important for government, academic institution and business area to collaborate in preserving cultural heritage.

The objective of this paper is to expose issues surrounding government, business, and academic institution (triple helix) preserving cultural heritage and to raise potential concerns for local communities involved in cultural heritage tourism. We take a case study of Saung Angklung Udjo, as a tourism business that has succesful implementation in preserving angklung and other sundanese culture as cultural heritage through triple helix collaboration.

2. Cultural heritage tourism

Cultural heritage tourism include tangible and intangible culture. Before beginning a discussion on preserving cultural heritage, it is helpful to find a working definition of "culture". UNESCO operates with a broad definition of culture as

> *…the whole complex of distinctive spiritual, material, intellectual and emotional features that characterizes a society or social group. It includes not only the arts and letters, but also modes of life, the fundamental rights of the human being, value systems, traditions and beliefs* (UNESCO, 2002).

The word "preserve" is defined as to keep something the same or prevent it from being damaged / destroyed or to add substances to something so that it stays in good condition for a long time. The *cultural heritage* may be defined as the entire corpus of material signs - either artistic or symbolic - handed on by the past to each culture and, therefore, to the whole of human kind (Jokilehto,1989).

Cultural heritage preservation" involves the preservation of the physical heritage of living societies, including their buildings, structures, sites, and communities. It includes the protection of landscapes that societies transformed through agricultural and industrial development. It embraces material culture, including artifacts, archives, and other tangible evidence. "Cultural heritage preservation" also encompasses the transmission of intangible aspects of a society, such as oral traditions, music, and community rituals (Coppin State University, 2002).

In his paper, George (2010) noted UNESCO position on intangible cultural heritage. On October 17, 2003, UNESCO, recognizing that ‘‘. . . intangible cultural heritage – or living heritage – is the mainspring of our cultural diversity and its maintenance a guarantee for continuing creativity . . . ’’ adopted the Convention for the Safeguarding of the Intangible Cultural Heritage (ICH) (UNESCO, 2003, Online Document) which states:

> [Intangible cultural heritage (ICH)]. . .*is traditional and living at the same time. It is constantly being recreated and mainly transmitted orally. The depository of this heritage is the human mind, the human body being the main instrument for its enactment, or – literally – embodiment. The knowledge and skills are often shared within a community, and manifestations of ICH often are performed collectively* (Online Document, What is Intangible Cultural Heritage?).

As noted by Ogden (2007), the intangible nature of cultural objects is being addressed and is seen as equal in importance to, or in some cases greater, than an object's tangible nature. This significant trend in cultural heritage preservation is increasingly evident in professional conferences, publications, and discussions, and is beginning to have an impact on preservation methodologies. It is affecting the way preservation professionals approach their work and manage collections. Understanding, respect, and collaboration are more important than ever in carrying out work. Understanding all natural aspects of the objects' significance, respecting an object's intangible as well as tangible nature, and collaborating in a meaningful way with the cultural groups to which the items are connected are playing an increasingly prominent role.

In theory, the opportunity for cultural learning in the 21st century is greater than ever. Globalization, in the form of world markets, free trade, and mass tourism, provides endless opportunities for the cultural interaction that opens the door for cultural dialogue (Reienfield, 2003).

3. Indonesia – a multi cultural country

3.1 Indonesian culture and characteristics

As noted by Czermak, *et al.* (2004), Indonesia as an archipelago of over eighteen thousand islands, has a rich and diverse multi-cultural and linguistic heritage. Over 700 languages are spoken by approximately 300 different ethnic groups. The largest ethnic groups are the Javanese at 45% of the total population, the Sundanese at 14 percent, the Maduranese, 7.5 percent, and others. In 1992, 26% of the population consisted of numerous small ethnic groups or minorities, representing the major part of Indonesia's ethnic diversity. Indonesia has national motto "Bhinneka Tunggal Ika", means Unity in Diversity, reflect the government's recognition and acceptance of the cultural, ethnical, linguistic and religious diversity of its people.

Based on data, it is clear that Indonesia is a multi-cultural country and its each culture has different characteristics. In preserving cultural heritage with many different characteristics, Indonesian government needs extra work and good coordination with other parties.

3.2 Angklung as one of Sundanese culture heritage

Sundanese tribe is rich in culture, including intangible and tangible culture. Sundanese culture has a lot of art, including the arts sisingaan and jaipong, typical Sundanese dances, puppet show, and Sundanese musical instruments that usually used in art performance.

The most famous of Sundanese music instrument is angklung. Kurnia (2003) in his article describe about angklung. Angklung is a musical instrument multitonal (double pitched), traditionally grown in the Sundanese community in the western part of Java Island. This musical instrument made of bamboo, sounded shaken by the way (the sound caused by impact bodies of bamboo pipes) so as to produce a vibrating sound in the arrangement of tones 2, 3, and 4 tones in every size, both large and small.

Fig 1. Angklung music instrument

4. Profile of Saung Angklung Ud¸-

Established since 1966 by Mang Udjo and his wife, U'um Sumiati, Saung Angklung Udjo as one of the creative industries is an example of how a traditional work successfully diffuses with modern business systems and business transformation in multiplied scale. By moving the performing arts peculiar angklung, Saung Angklung Udjo successfully expanded its business to a variety of traditional merchandise, event, Saung Angklung Udjo managed to become one of the major tourist destination for foreign tourists visiting the city of Bandung.

Now, SAU is one–stop cultural workshop, consists of:

- Performance venue: sundanese culture performance, including angklung music show, Sundanese dance, and many other cultural show
- Bamboo instrument workshop,and
- Bamboo handicraft centre shop

Performance is the main attraction at the SAU and core of SAU business. There are two performances: internal show (in the SAU) and external show (outside the SAU). Each type of show is packed in several packages. SAU also produces angklung and other music instruments made from bamboo. The angklung and other bamboo music instruments are made at bamboo instrument workshop. They produce thousands angklung for export and local demands. Besides the two core business, SAU also has bamboo handicraft centre shop as complementary business. At bamboo handicraft centre shop, SAU buy handicrafts from craftsman community and sell it to local and foreign tourists.

SAU grow to be Sundanese cultural district along with its vision, particularly the culture of bamboo, which fulfills the world with its reputation and become the main tourism destination in Indonesia. In order to fulfill its mission, to conserve and preserve Sundanese culture, Saung Angklung Udjo prove its seriousness by participating on registries Angklung, the Indonesian traditional music instrument made of bamboo, at UNESCO in order to protect the instrument as one of Indonesia's cultural heritage.

5. The Triple-Helix Collaboration at Saung Angklung Udjo

5.1 Triple Helix : A Theoretical Overview

Etzkowitz (2011) stated that the "triple-helix" refers to the multiple reciprocal relationships among institutional sectors (public, private and academic) at different points in the knowledge capitalization process (knowledge, consensus and innovation spaces). The 'Triple Helix' model of academia-industry-government relations is likely to be a key component of any national or multinational innovation strategy in the late twentieth century" (Etzkowitz and Leydesdorff, 2000). The concept of triple helix based on the concept of regional innovation environment (RIE), which consists of the set of political, industrial and academic institutions that, by design or unintended consequence, works to increase the local conditions for innovation.

There are several model of the triple helix model has been applied in developing countries. Etzkowitz et al. (2005) proposed several Triple Helix hybrids and the relationship between university-industry-government resulted in a focus from (i) incubator to incubation; (ii) from structure to process; and (iii) from firms to creating diverse organizations. In addition as transformers of knowledge, businesses is being formed by academics; industry was became partners in training ; and the financial for research and development was contributed by government.

In this research, SAU is one of successful example in implementation of preserving cultural heritage through triple helix collaboration. As tourism business, SAU hold cooperation with various parties to succeed in preserving cultural heritage. The academia as the incubator and transformers of knowledge, SAU as the businesses helice, and the government as the suporter and patner on distribute angklung as cultural heritage, together they make a collaboration and introduce angklung to the world as a part of Indonesia cultural heritage.

5.1 Angklung Diplomacy

With government, SAU make good cooperation in legal aspect. SAU cooperate with foreign ministry of Indonesia to distribute their product and introduce Sundanese culture to around the world. This cooperation is very useful to bring up the name of Saung Angklung Udjo to international tourism. Saung Angklung Udjo also can go international in performing their art and Sundanese culture product.

On the other side, the government also used angklung one of the tools of diplomacy, which is a part of public diplomacy. This diplomacy activity conducted on several ways such as teaching angklung classes for foreign people in other countries and inviting foreign artists as Art and Culture Scholarship Program for Indonesia (BSBI), conducting seminars and workshops on Angklung and presenting performances of inside and outside the country for a foreign audience.

The collaboration between SAU with the government, especially Foreign Ministry of Indonesia is a form of a total of diplomacy to achieve in all the stakeholders involved in the Indonesian diplomacy diplomatic efforts to secure national objectives. Last year, SAU receive a gorgeous challenge from Indonesian government to produce more than 150.000 per year for 2012 and 2013. Those angklungs will be spreaded all around the world as the implementation of SAU's unique method called "Angklung Diplomacy."

In other hand, SAU buy half-made angklung from surrounding society with quality standard that had set before. Along this way, SAU helps government to improve the communities around. No less than 1200 community members are included. This program is also one of corporate social responsibility of SAU.

5.2 Collaboration with academic institution

SAU also has been remaining its function as an educational institution, execute educational activities include training, Sundanese art and culture research, seminar and workshop. SAU consistently hold periodic trainings in order to achieve regeneration of crafts persons and trainers. Several universities support SAU by sending their student, to be SAU talents. Talents are the children who perform at the show. SAU teach the talents about how to play music with Sundanese music instruments. SAU also provide dance studio, in order to teach the talents about Sundanese dance.

Many universities often invite SAU to perform at their event. It helps SAU in their marketing strategy and also helps in preserving angklung as cultural heritage. Therefore, SAU has good relationship with many academic institutions. This proves that academic institutions have an important role in preserving cultural heritage by cooperate with tourism business.

Preservation of cultural heritage is important for the increased need of integration and expertise into higher education. Linking the university curriculum with cultural heritage in an interdisciplinary way is integral to further promote the importance of heritage for a sustainable future. Through teachings, conducts research and makes documentation related to the origins and development of the various types of angklung of Indonesia both traditional and modern and also carry out these documentations of the varieties of angklung arts and products in order to increase public awareness of angklung cultural heritage, the need for joint cooperation between professionals and academics to achieve common goals will come out vividly.

5.3 Role as tourism business

SAU execute their business with holds the family business principle and has the structure of business organizations such as the middle class in general. As tourism business, SAU has profit oriented, where it is reflected on its idealism: "Art for Mart". Art for mart is a form of idealism that puts cultural heritage as precious commodity that can bring SAU to achieve some financial objectives, which is manifested on business profit from each angklung performance of SAU.

Although SAU is profit oriented, SAU holds such a deep cultural value in doing their business. Besides "Art for Mart", SAU has "Art for Art" idealism. "Art for Art" means art is the main principle in executing their tourism business. Art for mart is a form of idealism that puts cultural heritage as precious commodity that can bring SAU to achieve some financial objectives, which is manifested on business profit from each Angklung performance of SAU.

Preserving cultural heritage aligns with the principle of "Art for Art" of SAU. In order to give sustanaible best performance of angklung in every performance, SAU carry out development of infrastructure of training in angklung cultural heritage, consisting of a training centre and a music studio, in order to accommodate more training activities and regeneration of players and trainers in angklung and also development in infrastructure for production of the traditional handcraft of angklung making, in order to produce good quality angklung instruments.

5.4 Conceptual framework

From Saung Angklung Udjo case study we proposed a conceptual framework in accordance with triple helix concept. In triple helix concept, the industrial sector operates as the locus of production; government as the source of contractual relations that guarantee stable interactions and exchange; the university as a source of new knowledge and technology, the generative principle of knowledge-based economies.

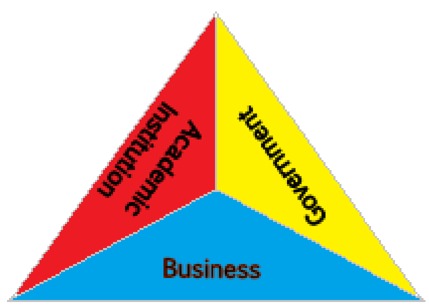

Fig 2. Framework of Triple Helix Collaboration

SAU has proven that through tourism business, it can be successful way to preserve cultural heritage with collaboration with government and academic institution. Their relationship with cultural heritage is reciprocal because preserving cultural heritage give many contribution to all parties. Grazuleviciute (2006) in his article state that an important role of cultural heritage striving for sustainable development is its relation with resource productivity and economic development.

He also state several contribution of cultural heritage:

- The important impact of cultural heritage and heritage preservation is city center revitalization
- The next economic benefit generated by cultural heritage is heritage tourism
- One more contribution of cultural heritage is its big role in small business

This discussion leads to the initial propositions of triple helix collaboration in preserving cultural heritage:

P1 Government can improve preservation of cultural heritage with help tourism business in distribution and promotion of their product

P2 Tourism business has a great advantage in preserving cultural heritage by cooperate with academic institution in familiarization to the domestic community

P3 Relationship between tourism business, government, and academic institution in preserving cultural heritage is reciprocal, which lead to enhancement of sustainability development

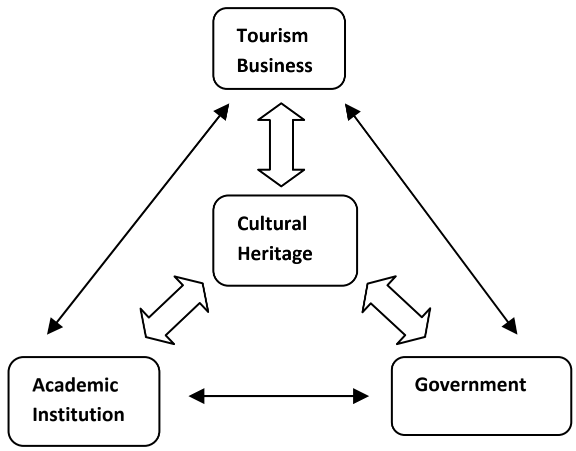

Figure 3. Framework of preserve cultural heritage through triple helix collaboration

6. Conclusion

This study gives an overview that the nation's cultural heritage is an asset which, if managed properly can provide benefits and can improve the condition of the nation both financially and non-financially.

Condominas (2001) notes that, “a traditional popular culture should be considered from the standpoint of the group which created it and which keeps it alive.” New approaches to preserving cultural heritage emphasize people themselves should join together and collaborate.

In preserving cultural heritage, there are many parties should be involved. Triple helix collaboration is the proper way to keep cultural heritage sustainability. Saung Angklung Udjo (SAU) as one of tourism business has successful implementation at building cultural heritage as their core business by combining the role of government, academic institution, and business. The interactions between government, business and academician, in the case of SAU can spur the effort capacities and capabilities of preserving cultural heritage, and also can raise potential concerns for local communities involved in cultural heritage tourism and see cultural heritage as a profitable precious commodity.

7. Further Research

The function of triple helix collaboration in cultural heritage is relatively new topic and very little research has been performed in this area. This paper will be extremely valuable to researchers and practicioners who are currently engaged in cultural heritage research. Important questions and directions for further research can be formulated as follows:

a. How does the SAU develop its company from family business scale to international business scale, and still successfully survive in conserving cultural heritages well as marketing it as a profitable commodity?
b. Is the triple helix model of collaboration in the case of SAU can be generalized and applied to the other case of preserving cultural heritage in developed countries?

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References

Condominas Georges. 2001. Introduction, In: Viet Nam's Cultural Diversity: Approaches to Preservation, UNESCO Publishing, Edited by Oscar Salemink

Coppin State University, Goucher College Morgan State University, and National Park Service. 2002. Teaching Cultural Heritage Preservation: A course Outline. USA

Czermak, K., Delanghe, P., and Weng, W. 2004. Preserving intangible cultural heritage in Indonesia, UNESCO Jakarta

Ekwelem, V.O., Okafor, V.N., and Ukwoma S.C. 2011. Preservation of Cultural Heritage: The Strategic Role of the Library and Information Science Professionals in South East Nigeria. Library Philosophy and Practice
Etzkowitz, H. 2002-2011. The Triple Helix of University - Industry – Government Implications for Policy and Evaluation. Science Policy Institute Working Paper, available at http://www.sister.nu/pdf/wp_11.pdf
Etzkowittz, H, JM Carvalho De Mello and M Almeida (2005). Towards "meta-innovation" in Brazil : The evolution of the Incubator and the Emergence of a Triple Helix. Research Policy, 34, 411-424.
Etzkowitz, H and L Leydesdorff (2000). The Dynamics of Innovation : From National Systems and "Mode 2" to a Triple Helix of University-Industry-Governmental relation. Research Policy, 29, 109-123.
George, Wanda. 2010. Intangible cultural heritage, ownership, copyrights, and tourism, International Journal of Culture, Tourism, and Hospitality Research. Vol. 4, Emerald Group Publishing Limited
Grazuleviciute, I. 2006. Cultural heritage in the context of sustainable development. Environmental research engineering and management. Vol.37 No. 3, pp. 74-79
Gunlu, E., Yağcı, K., and Pirnar, I. 2008. Preserving cultural heritage and possible impacts on regional development: a case of izmir. Dept. Of Tourism Management, Tınaztepe Campus. Turkey
J. Jokilehto. 2005. Definition of Cultural Heritage, References to Documents in History. ICCROM Working Group 'Heritage and Society.
Kurnia, G. 2003. Deskripsi kesenian Jawa Barat. Dinas Kebudayaan & Pariwisata Jawa Barat, Bandung.
Ogden, Sherelyn. 2007. Understanding, Respect, and Collaboration in Cultural Heritage Preservation: A Conservator's Developing Perspective. LIBRARY TRENDS, Vol. 56, No. 1, Summer 2007 ("Preserving Cultural Heritage,"), pp. 275–287 . The Board of Trustees, University of Illinois
Reienfield, Marti Ann. 2003. Tourism and the politics of cultural preservation: A case study of Buthan. Journal of Public an International Affairs, Volume 14/Spring, the Trustees of Princeton University
United Nations Educational, Scientific and Cultural Organization. 2002. Issues on Culture and Development. http://www.unesco.org/culture/development/index.shtml , retrieved 02 February 2012
UNESCO. 2005. Cultural Tourism, Available from:
http://portal.unesco.org/culture/en/ev.phpurl_id=11408&url_do=do_printpage&url_section=201.html , retrieved 01 February 2012
World Tourism Organization: Tourism 2020 Vision, http://unwto.org/facts/eng/vision , retrieved 02 February 2012
http://www.angklung-udjo.co.id/about/corporate/ , retrieved 03 February 2012
http://www.angklung-udjo.co.id/about/history/ , retrieved 01 February 2012

VALUE CHAIN ANALYSIS IN DESIGNER-MAKER INDUSTRY: A CASE STUDY OF BANDUNG, WEST JAVA, INDONESIA

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Abstract
This paper provides a value chain analysis of Bandung's designer/maker industry and identified gap between customer needs and supply chain within the activity of the industry. The study presents two case-study of Bandung Designer-Maker supply chain which interprets how the value chain analysis method were applied to identified issues within the supply chain activities.

Keywords: Value Chain, Desginer/Maker, Fashion

1. Introduction

Bandung has become famous for its creative industries development in Indonesia. Since 1997, following the monetary crisis, the number of creative business is increasing rapidly. Despite some dire economic condition, creative businesses are able to provide job opportunities with no or less effect from global changes. Within the creative industries, the fashion industry continuously shows the highest rate of growth

To date, the growth of fashion industry is still going strong. Accordingly, the degree of competition within the industry is intense. With its development, a number of established retailer and manufacturer have slowly developed new business models. One of which is the designer-maker business model. The term ‘designer-maker’ literally describes what these people do and highlight the fact that they both design and manufacture their own products. Different designer-makers have different thinking motives - from those who believe that the best designs come from those who are masters of their medium (idealism thinking) to those who take pleasure, habit or convenience out of their own designs (realistic thinking). Different with other form of fashion businesses, designer-maker business has a unique business model characteristics which allows them to have additional sources of income. On top of their own capability to enter the market by offering their own products, they can also offer made to order services to customer (customized design). As the demand for both of product and service being offered is very high and the high volatility of the industry, these designer-makers should creatively and effectively manage their value chain. Although they developed a new business model which can minimize business risk and increase (potential) revenue, there are some issues within their business process which need to be managed.

Increasingly, supply chain management has evolved into value chain management which recognizes the importance of demand in addition to supply (Marzian et al., 2003). Value chain analysis can be defined as a “structured method of analyzing the effects of all the core activities on cost and/or differentiation of the value chain; value chain analyzed where in the supply chain the costs can be reduced or differentiation can be enhanced” (Dekker, 2003). It was Michael Porter of Harvard Business School (Porter,1985) who introduced the method of analyzing the competitive advantage and the idea that key processes across the supply chain form a value chain. Researches and analysis of value chain in various industries identified different characteristics unique to each industries and drive the advancement of value chain management theories. On the other hand, Taylor (2005) argued that value stream analysis is very important to assess the opportunities and possible approaches to develop significant improvements in the efficiency and competitiveness of value chains.

In the context of this study, the following research question were formulated:

RQ1. What is the value chain of designer-maker industry in Bandung?

RQ2. Using value chain analysis technique, what improvement should be made in designer-makers supply chain in Bandung to address their problems?

7.1. Methodology

1.1 Structure

This study uses a case study approach. Based on McCutcheon and Meredith (1993), a case study research in operations management is recommended in order to close the gap “between operations management research’s prescriptive advice and workable answer for managers". In this study, case study method includes interview, protocol analysis, field studies, and participant observation. Types of data that were analyzed includes documents, archival records, interviews, direct observation, participant observation and artifacts analysis. As the information collected, data was interpreted by coding. Coding was done by systematically searching data to identify and or categorize specific observable actions or characteristics.

A Value Stream Management System (VSMS) analysis is then conducted within each of the case study respondents. VSMS simplifies the planning process for lean implementation, ensuring quick deployment and greater success. It links the metrics and reporting required by management with the lean tools needed on the manufacturing floor. The central feature of this illustrative and engaging book is the value stream management storyboard, a tool representing an eight-step process for lean implementation. The storyboard brings together people, tools, metrics, and reporting into one visual document 1. According to Hines and Rich (1997), elements of the value stream mapping techniques were applied to collect some base data; particularly process activity mapping and demand amplification mapping.

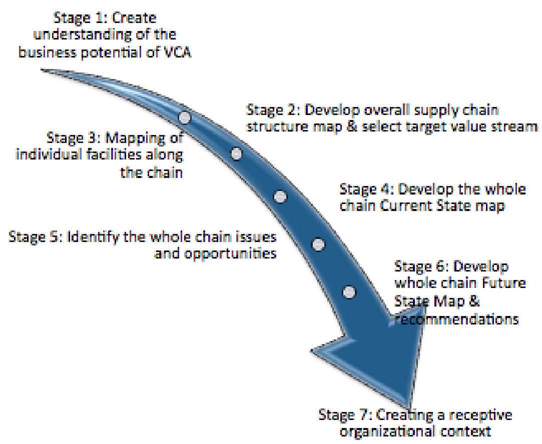

Figure 1. Summary of Value Chain Analysis Methodology (Taylor, 2005)

1.2 Respondent Profile

This study mainly unitized data from case study of two designer makers in Bandung, West Java.

1. Fragrance

Established designer-maker Kiki Chan launch her own label 'Fragrance' back in 2008. Started from offering custom orders, the label gradually produced ready-to-wear fashion line. Kiki started the business with just one sewing machine. The business now has its own place and 5 permanent employees (tailors) with annual turnover reached IDR 100 million per year. Fragrance excel in due to its unique design - uncommon color schemes, asymmetrical cutting, and different alloy materials commonly used in interior design is characteristic of its design. The price for ready-to-wear products is ranging from IDR 700.000 to IDR 1 million while made-to-order products price depends on the material used and the degree of difficulty. Until now the label does not have its own shop. It sells its product through several consignment stores in Bandung and Jakarta. Fragrance produced seasonal ready-to-wear line every 3-4 months. Its operational system is FIFO method (first in first out) with raw materials kept to stock. Made-to-order products are always a priority on the work schedule. Tailors can produce one regular design dress a day and made-to-order dress or jacket can take 3-4 days. The production of ready-to-wear products is always scheduled between every made-to-order production. Each tailor is expected to produce at least 15 pieces in a month. Ready-to-wear production can be twice faster to make than made-to-order products because the design is simpler.

2. By Catch

‘By Catch’ is a label established by two sisters, Kiki and Irmasari. Irmasari is a graduate from Arts Department of Institut Teknologi Bandung which was always interested in venturing into the fashion business since she was in college. She decided to quit her former profession as a designer about two years ago. With her sister, she started a production house for fashion products; accepting order to manufacture product from other designer. Throughout its development, services offered grow from production only to design services. Today its turnover reaches more than IDR 150 million per year with 10 employees, including administration staff and production assistant with design is only solely done by Kiki and/or Irma. Bycatch offers unique custom design, quality product, and special techniques order not offered by its competitor. Every three month the label issued a line of 15 style products. Each line will only made a minimum of 2 dozen per style and reproduced according to market demand with prices ranging between IDR 300-700 thousand. To date the label does not have its own shop, selling through consignment store in Bandung, Surabaya, Jakarta, Makassar and Yogyakarta.

3.Introduction

1.1 Problem Identification

Field work reveals some issues that hamper the development of designer makers business. Designer-makers are charging every design by personal standard based on their own value proposition. Either for the mass-market product line or for the custom order, each designer needs to allocate time and resources to create new designs. It becomes an issue from business perspective when these designs were not used because of unavailability of fabric desired, or full capacity of production, or designs which are considered do not capture market demand.

Another major issue is the number of reject products. Although designer-maker usually has a sampling system for every piece of design, the number of reject product is still considerably high - especially for the mass-market product. This is happen because of the design complicatedness due to idealistic thinking. In one side, it becomes the trademark of every designer-maker. But on the other hand, some of these idealistic designs become a business concern because of rejection from the market itself.

The third big issue is long replenishment cycle. Because the focus of production is divided into mass production and custom order, it caused delay in the replenishment cycle. The mass production product usually issued every three or four months in the consignment store or their own store. In times where custom order is increasing, it directly affects the mass product production because of production schedule challenges.

The last issue found is the problem of unmet demand. Designer-maker usually does the creative activity by him or herself. Sometimes they have assistant(s) who helps, but usually does not have any authorization with the final creative work. This condition have its own challenges designer-makers to effectively manage time in order to fulfill all custom orders as well as demand for the mass production product customer. There are times within a period of one year that there is a sudden enormous increase in demand from both markets, which usually cannot be fully filled by designer maker. This loss of sale is becoming a major issue for the business. Not only in terms of financial gain, but also this kind of problem can hurt the credibility of the brand itself.

1.2 Research Phase

I. Stage one: creating understanding of the business potential of value chain analysis

The scope of research and its objective were explained to respondents before interviewing. The benefits of the research also were introduced along with the importance of value chain analysis and the concept of lean supply chain. As a criteria, respondents should have understanding of the business process as a whole and understanding of all factors and trend in designer-maker industry.

II. Stage two: understanding supply chain structure and selecting target value stream

Value chain analysis is aim to improve supply chain performance. According to Taylor (2005), because most firms are part of complex supply networks, they usually do not have a clearly defined picture of their supply chain structures. Therefore, a supply chain structure map is needed to be developed as the first step of value chain analysis.

The selection of a specific value stream is required in value chain analysis, particularly to be the focus for initial analysis and improvement (Jones & Womack, 2002). Value stream analysis is based on the idea that the firm consists of a sequence of activities, each of which is designed to add some value to the product or service as it moves towards the customer. The key strength of value stream analysis is that it quickly focuses on where change is needed and reveals opportunities for change. (Tidd et al., 2005). Figure 2 shows the designer-maker supply chain structure developed from the field work.

According to Taylor (2005), selection of the target value stream across a whole supply chain involves three aspects. First, it is essential to determine the scope of value chain project in terms of the distance along the chain to be included. In these case studies, the scope included everything from production to the sale of fashion product. It did not include activities upstream of cloth production. Second, the selection of a specific pathway is also very important. For this selection, the flow volume data on the supply chain structure map may give a logical basis (Taylor, 2005). In these case studies, the pathway which was chosen includes small designer-maker enterprises. Third, the identification of a target product group is required in order to make a value stream selection. In these case studies product selected was the customized clothes and ready to wear clothes.

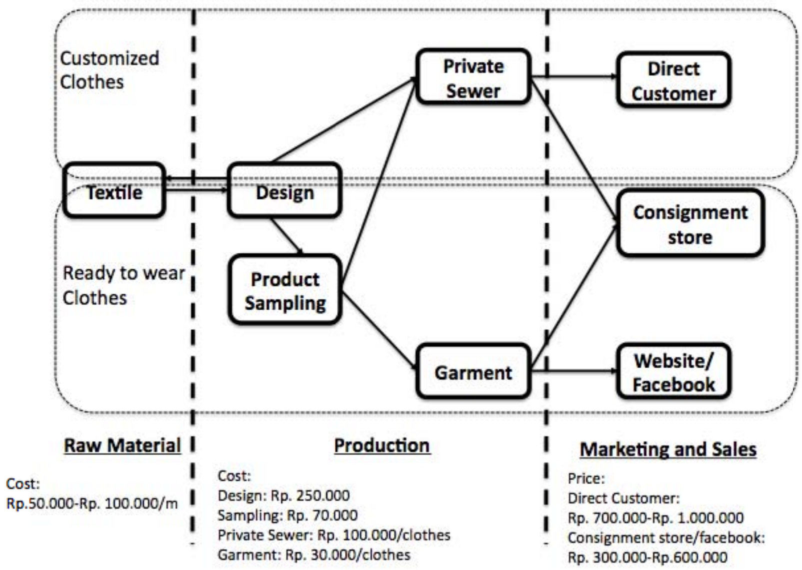

Figure 2. Value Chain in Bandung Designer Maker Industry

III. Stage three: analysis of the individual facilities along the chain

To understand the overall supply chain, the individual plants and facilities along the chain were analyzed. Each facility was visited and the products were followed through all processes. After that, process activity mapping were conducted and product forecast and demand information were tracked. The outcome of the previous process is the current state map. The current state map tells where the company is, shows where the company wants to go, gives the company a plan on how to get there. Using the current state maps, a future state map and a SMART (specific, measurable, achievable, realistic, and timed) action plan could be developed for each element in value chain. The future state maps were developed in a lean context by reference to the five lean principles, specify what creates value from the customers perspective, identify all the steps along the process chain, make those processes flow, make only what is pulled by the customer and strive for perfection by continually removing wastes (Womack & Jones, 1996) and the key features of a lean value stream by Rother and Shook (1998).

Raw Material		Production		Marketing and Sales		
Textile supplier	Textile manufacturer	Product Sampling	Product Production	Direct Customer	Consignent store	Internet
Fuctions:	*Fuctions:*	*Fuctions:*	*Fuctions:*	*Fuctions:*	*Fuctions:*	*Fuctions:*
Suply of finished cloths: 0-1 week	Supply of ordered cloth: 0-20 weeks	Sampling product before production: 0-1 week	Production and plastic packing: 0-4 weeks	Special packing	Retail pack Price & Label display	Photography and internet display
Output:	*Output:*	*Output:*	*Output:*	*Output:*	*Output:*	*Output:*
Ordinary Textile	Customized Textile	Product sampling for every series of ready to wear products	Ready to wear products and customized product	Special packing for every customized product	Retail display with 12-14 series multiply by 2-3 dozen of ready to wear products every 3-4 months	Internet display with 12-14 series multiply by 1-2 dozen of ready to wear products every 3-4 months

Figure 3. Structure of the target value stream of designer-maker

IV. Stage four: developing the current state map of the whole value chain

After conducting the stage three: analysis of the individual facilities along the chain, the current state map of the whole value chain was developed. Information flows, physical product flows and time are the three key elements recorded in this map. The current state map for designer-maker is shown in Figure 4. Based on Taylor D,H (2005) and Forresrer (1958), an important additional dimension when mapping the complete chain is the requirement to analyze demand dynamics, with the aim of identifying variability and amplification effects along the chain. However, since the case study was conducted in small designer-maker enterprises, historical data of demand order and forecast is very hard to find.

V. Stage five: analysis of issues, and opportunities along the whole chain

Creating the map for the whole value chain uncover some issues and opportunities for improvements. Opportunities available on the current estate and mapping will be explained in the next step. Examples of some of the issues were:

- Issues related to information slow. Slow information from marketing and sales department to production department create a number of unmet demands.
- Issues related to management. Selection of consignment store that has a sales reporting system that must be addressed quickly and properly. Supervision of the production department (quality control) should be tightened to a faster production time. Setup adequate inventory to cope with unpredicted demand must exist policy.
- Issues related to product flows. There is no alignment between availability of inventory in consignment stores and products on the website.

VI. Stage six: development of the whole value chain future state map and recommendations

In order to improve the efficiency and minimize unnecessary and in order to achieve lean management, some improvement is recommended as shown in figure 5, which mostly focuses on operational aspects.

a. Develop supplier association. Companies should establish good relationships with several major suppliers to get the ease and speed in materials ordering. Relationships can also be formalized in the form of formal cooperation.
b. Develop demand management policy. Another thing that the company must make is a policy on the market demand; which order must be fulfill first by always refering to the demand forecast strategies.
c. Develop strategies fir demand forecasting. Companies must create a strategy for forecasting the possibility of an increase or decrease in demand driven by market conditions or seasonal trends. Some possible market conditions including when there is a popular item with fast turnover that should be reproduced before the inventory is empty. On the other hand there is seasonal trend when there are big annual celebrations like Eid, Christmas, and school holidays where demand has historically increased considerably.
d. Develop quality management policy. The company should have a SOP (Standard Operating Procedures) on Quality Control and Quality Assurance standards. Checks should be done regularly in order to minimize errors that can increase inefficiency and cost.
e. Increase production schedule effectiveness. Because the designer-maker serves two different types of consumers (made-to-order and ready-to-wea), manager should be able to manage the production of both types of consumer goods so as not to interfere with each other. Lways refer to demand forecast.

f. Develop replenishment policy. The weakness of designers maker is slow on replenishment cycle. There should be a good communication between regularly established consignment maker and the stores where when one product is close to sold out, goods are then replenish to avoid zero inventory.
g. Develop inventory planning. In anticipation of increased demand due to seasonal demand, it helps the designer maker to take a little risk by having inventory in order to avoid unmet demand.

VII. Stage seven: creating a receptive organizational context for value chain improvement

To increase efficiency of the value chain, changes must occur at the organizational level. Designer-maker as the owner of the company must adopt a new strategy as suggested. The strategy should be implemented gradually with close guidance. The strategy is still continuously be assessed continuously during implementation so that it can continue to be changed accordingly.

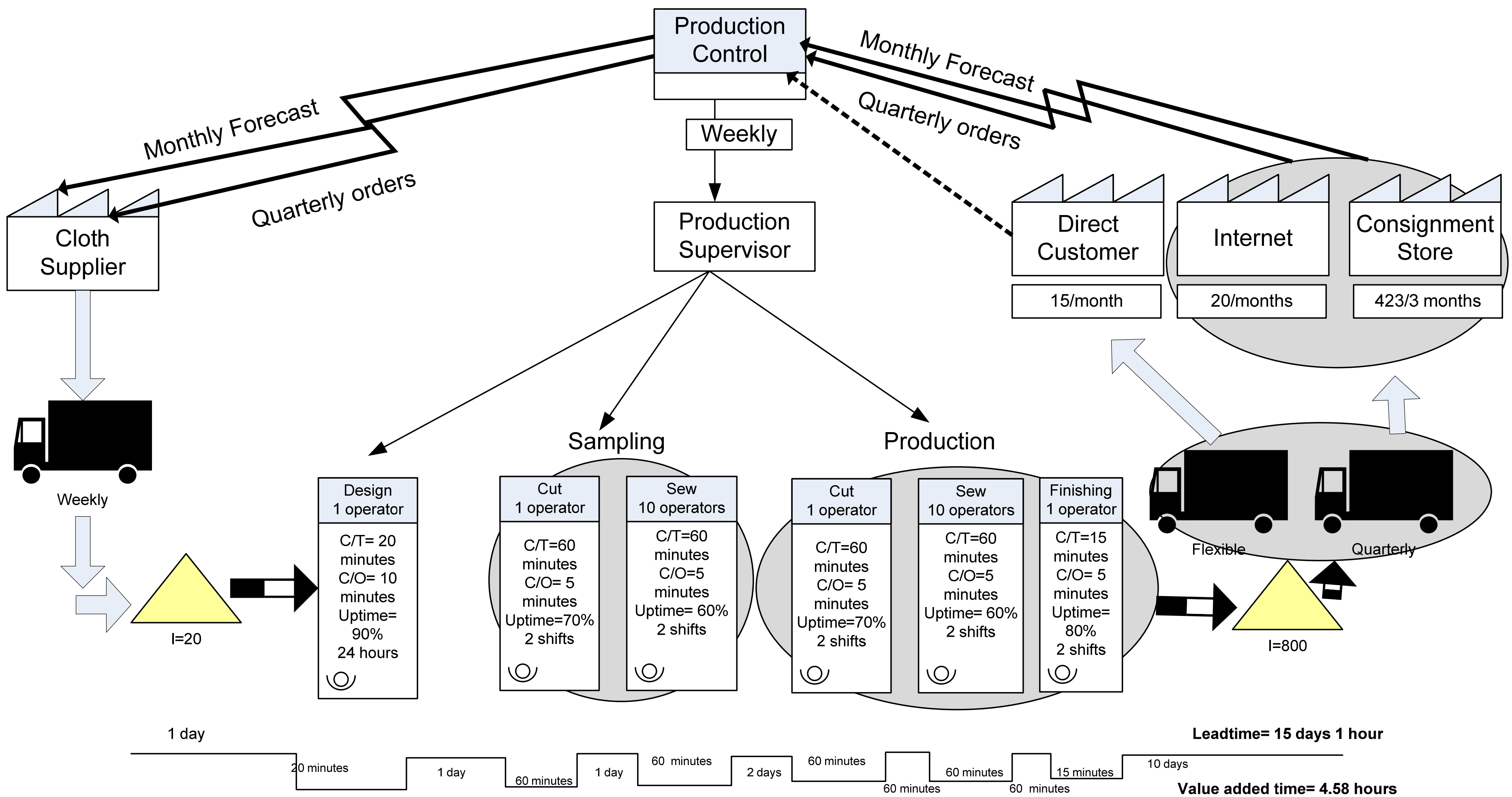

Figure 4. The current state map for designer-maker

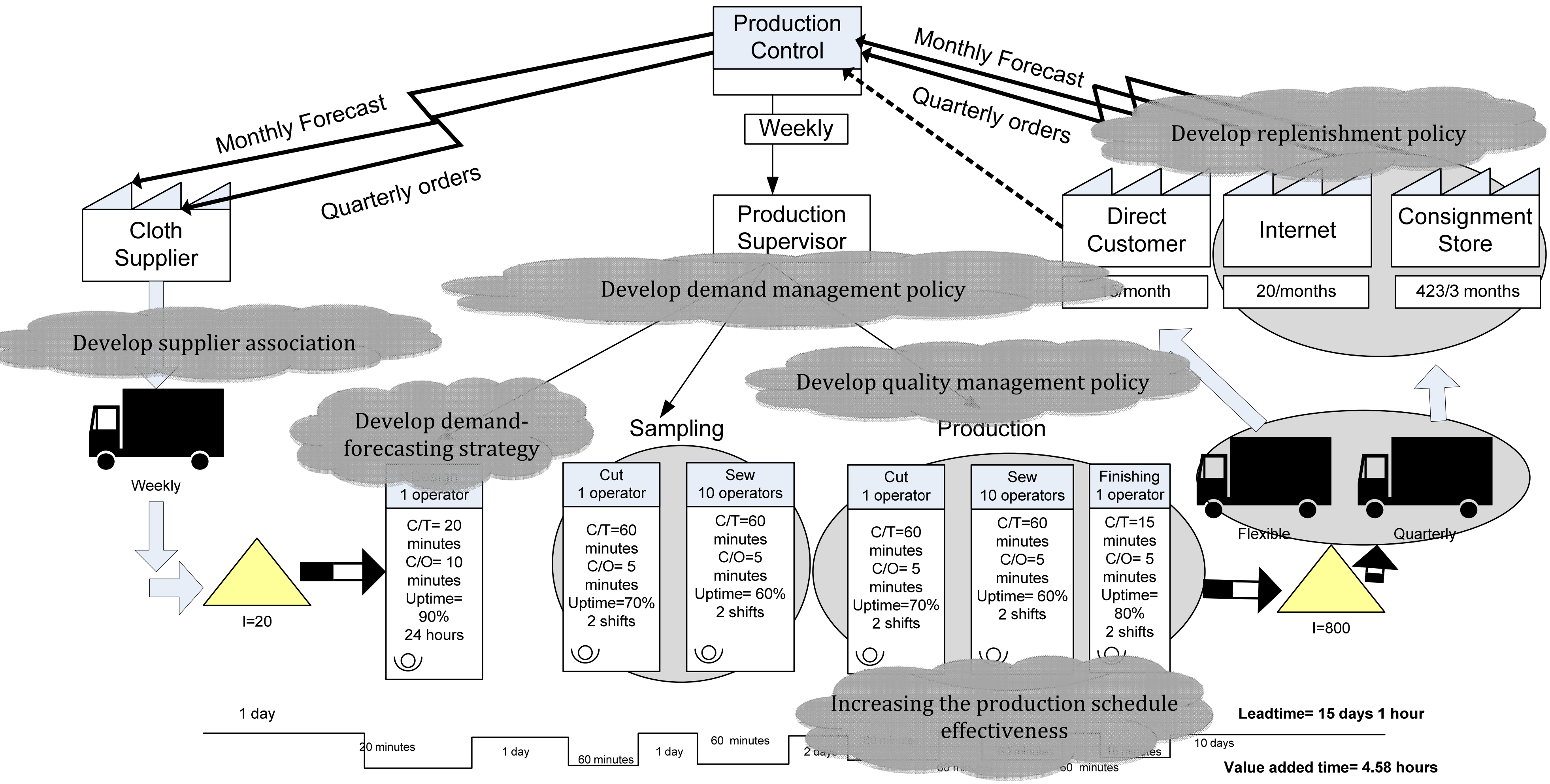

Figure 5. Improvement in current state map for designer-maker

2. Conclusion

Issues have been covered with seven recommendations. With its implementation there should be consistency of policy at all levels in the organization. It is unlikely that a single policy measure will be capable of optimizing the condition of the company. Rather, a strategy is likely to contain a set of different instruments. Which of these tools are important to develop the company will be carefully and thoroughly investigated in the application of the recommendation.

References

Van der Geer, J., Hanraads, J. A. J., & Lupton R. A. (2000). The art of writing a scientific article. *Journal of Scientific Communications*, 163, 51 - 59.

Dekker, H.C., (2003). Value Chain Analysis in Interfirm Relationships: a Field Study. *Management Accounting Research*, Vol.13 No.1, pp.1-23.

Forrester, J. (1958). *Industrial dynamics a major breakthrough for decision makers*. Harvard Business Review, July/August.

Jones, D., & Womack, J. (2002). *Seeing the Whole-Mapping the Extended Value Stream*. LEI: Brookline, MA.

Koh, E. C., & Nam, K. (2005). Business Use of the Internet, A Longitudional Study rom a Value Chain Perspective. *Industrial Management & Data System* Vol.105 No.1.

Marzian, R., McLaughin, J., & Andraski, J. (2003). Foreword in Dirk, S. (Ed.) *Collaborative Planning, Forecasting, and Replenishment: How to Create a Supply Chain Advantage*, American Management Association: Chicago, IL.

Preece. A. (2005). The Performing Arts Value Chain. *International Journal of Arts Management,* Vol. 8 No. 1, pp. 21-32.

Zokaei, K.A., & Simons, D.W. (2006). Value Chain Analysis in Consumer Focus Improvement, A Case Study of the UK Red Meat Industry. *The International Journal of Logistic Management,* Vol.17 No.2, pp.141-162.

B. Triple Helix Collaboration for Small and Medium Enterprises

QUALITATIVE APPROACHES AS FORMATIVE EVALUATIONS: THE MISSING LINK IN THE PUBLIC SUPPORT TO SMEs

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Abstract
This research explains the complementarities of the qualitative and quantitative approaches to evaluate programmes that assist small and medium enterprise (SME) innovation. Our approach is based on case studies, a rigorous management of the interaction with the subjects, and the analysis of both the outcome of the SME initiatives and the contribution of the programmes to this. We compared the results of our evaluations with the results of the formal evaluations carried out by the policy administrators on behalf of the funding bodies. In most cases, we found unsuccessful innovation attempts, poor programme services, but extremely positive formal evaluations. Then, we explained various negative consequences of the results of the formal evaluations. Specifically, in the selection of programmes to allocate public funds and in the external control of the programmes performance executed by the policy administrators, in the internal performance management systems in programmes to direct and assess the work of the consultants, as well as in the aggregated evaluation of policies done at the highest levels of governance. We conclude suggesting several initiatives to improve the whole evaluative practice, namely the selection of suitable targets, when the qualitative evaluations should be employed jointly with proper quantitative techniques, the disconnection of the evaluator organizations from the policy-makers and program organizations, the utilization of an evaluative approach similar to the one employed in this research, and the specification of the profile of the professionals in charge of the evaluations.

Keywords: Program evaluation, Quantitative and qualitative methodologies, Policy process, Diffusion of innovations, SME information systems

1. INTRODUCTION

SME policy has become an important element of many government strategies in producingnational competitive advantages (e.g. Greene et al., 2007; Nugent and Yhee, 2002). However, despite the importance of SMEs and the response of governments, there has been numerous critics tothis type of support (e.g. Curran, 2000; Dannreuther, 1999; Johnson, 2005; Martin and Matlay, 2001; 2008; Mole, 2002; Nugent and Yhee, 2002; Oztel and Martin, 1998; Storey, 2006; Vega et al., 2008, 2010).

To complicate the SME policy context, the important theme of evaluation has also received several critics (e.g. Curran, 2000; Curran and Storey, 2002; Lenihan et al., 2007; Patton et al., 2003; Storey, 2006). Most of the evaluation approaches to the public programmes oriented to SME innovation have been *quantitative* in nature (Curran and Blackburn, 2001; Curran and Storey, 2002; Patton et al., 2003). As we will see in this study, there are two basic characteristics that determine a negative and enduring context whichwould influence the evaluation results of SME policies, namely the evaluation mechanisms and a power relationship between programme organisations and SMEs (Vega et al., 2010).

The research embraces the interaction of the three core triple helix components, namely governments, universities and industry. More specifically, this research is about the implementation of SME policies by universities. The findings, conclusions and implications have general applicability, including develop and developing countries, and sector and regional policies.

We start discussing the quantitative and *qualitative*practices as well as the potential contributions of a mixed approach in the evaluation process. After this, we explain the methodology used in this research, i.e. case studies. The cases illustrate the complementarities between the quantitative and qualitative approaches. Then, we explicate some consequences of the employment of incorrect evaluations in the policy process. We conclude recommending a set of considerations to improve theentire evaluation cycle.

2. EVALUATION APPROACHES

2.1 Quantitative Approaches

One core objective of evaluation is to determine the *additionality* created by the policies. It means the impact generated on society exclusively attributable to the programme interventions. The type of impact, or *targets*, should be measurable and aligned with the policy it wants to assess (Harrison and Leitch, 1996; Storey, 2006). One example could be the consultancy to SMEs regarding an innovation. In this case, a proper evaluation could contemplate the number of SMEs that correctly implemented and use the innovation.

The framework developedby Storey (2000) gives a clear example of the different *levels of sophistication*of the quantitative practice ofevaluationof SME policies regarding additionality.Level one measures the take-up of the services, level two accounts for the satisfaction of the owner-managers regarding the services, and level three adds the opinion of the owner-managers about the additionality generated by the programmes.Clearly, the first two levels do not tell anything about the effectiveness of the policies. The third level, evidently,lacks validity given the difficulty for the respondents to separate the effects of the programmes from other factors affecting the SMEs (Curran and Storey, 2002; Vega et al.2008, 2010). In addition,Lipsky (1980, 2010) argues that public service workers have power over the clients given their capacity to constrain access to the services and control benefits.

Levels four, five, and six incorporate control groups, which makes these levels more rigorous than the previous ones. Level four uses typical firms as control groups. Level five considers SMEs that match with the programme participants in observable aspects such as sector, size, and location. Level six employs the most accurate approach adding to level five the use of sophisticated statistical techniques, such as sample selection modelsand self-assessment approaches. Basically, these techniques take out of the effects of selection bias. In the context of evaluation of SME-oriented programmes, selection biashappensbecause the SMEs that apply to get public services and the ones that are finally chosen by the programme workers normally are the most ambitious and resourceful companies, which could have succeed even without public support. Undesirably, the first three levels are by far the most common practices in industrial policy (Lenihan et al., 2007).

2.2 Qualitative Approaches

The qualitative approaches should be employed when the aims of the evaluationsareto understandhow, why, and under what circumstances policies work or do not work. After reading diverse authors (e.g. Davis, 2000;McDavid and Hawthorn, 2006; Patton, 2002;Popay and Williams, 1999; Williams, 1986), we defined a set of*objectives*for which it is convenient to do qualitative evaluations. One case is when the evaluator wants to explore the complexity of the social realm that was assisted and the potential for the interaction of different programmes. A qualitative approach is also appropriate to determine what components of the programmes contributed to the success of the clients. Other scenario is when the aim of the evaluation is to identify unintended outcomes of the programmes.Finally, qualitative methods are valuable to explore programme practices and the underlying contexts that direct programme workers towards objectives that could,or could not be aligned withsocial goals.

2.3 A Mixed Approach

As we will see in the case studies, all the qualitative objectives were addressed in this research.Furthermore, we evaluated the formal evaluations done for the funding bodies, which were at most located atthe level three of the quantitative scale. The use of two evaluative methodologies in a particular case has practically not done in the field of SME policy research, e.g. Greene (2009: 216) commented that'[he was] unaware of a study that has investigated if different evaluation methodologies do lead to differences in the type of evidence generated for a specific programme…'.

One core aim of this study is to demonstrate the value of the qualitative methodologies. We believe that a qualitative methodology like the one used here should be complementary to the proper application of quantitative approaches, for example the ones at level six of sophistication (e.g. Curran and Storey, 2002; Lenihan et al., 2007).

The inclusion of a comprehensive diversity ofevaluative objectives and the application of multiple research approachesresemble the philosophical stance adopted by the realistic evaluators, for example Henry et al., (1998), Kasi (2003),and Pawson and Tilley (1997).In fact, a combined methodological approach is necessary to identify the surface problems in the SMEs and from there to understand the generative structures and mechanisms within the policy systems that actually brought about the design and administration of policies as well as the events in the public assistance and innovation processes. We believe that this multilevel ontological perspective is anappropriate way to understand the systemic and changeable nature of evaluation. What is more, as this mixed approach is aimed at finding underlying problems, this realistic evaluative practice becomes instrumental to recommend meaningful actions to policy practitioners in order to design and deliver proper services which move the SMEs towards increased chance of success (Pawson and Tilley, 1997).

2.4 A Concern about Qualitative Validity

It is pertinent to point out thatthe qualitative approaches to evaluation are not free from critics. Certainly, manyresearch authors agree that the construct validity is a problematic issue, above all in interviews. Specifically to qualitative evaluation practices of SME-oriented programmes, Ramsey and Bond (2007: 405) stated that 'a major problem is that simply to 'ask the question' in an appropriate open-ended method is generally insufficient'. More generally, Klein and Myers (1999) defined the principle of interaction between the researcher and the subjects to evaluate how the data is socially constructed though the research process.
We acknowledge this methodological concern in the context of the evaluation of SME policies, but we believe that we overcame this problem with the way we developed the fieldwork.In fact, our fieldwork process is another contribution to the practice of evaluation. We will revisit this issue in the rest of the paper.

3. RESEARCH DESIGN

3.1 Methodology

We used an arrangement of six case studies (e.g. Benbasat et al.,1987; Lee, 1989; Yin, 2009) of information systems (IS) innovation processes in SMEs and the programme assistance that they received. The analysis was deductive and used the pattern matching method of Trochim(1989). In order to understand the evaluation results, we are considering as explanative variables the adequacy of the formal evaluation mechanisms and the possible presenceof power in the interaction of programmes and SMEs. In addition, we used the replication concept of Yin (2009), with the aim of strengthening the constructvalidity of the findings and illustrate diverse examples of the contrast between the results of the formal evaluations and the actual outcomes of public support.We will develop in detail one of the cases but show the summary results of all of them.

3.2 Analysis

We found early on in practically all the cases the inadequacy of the formal evaluation mechanisms and the presence of power in favour of the programme workers over the SMEs. We could also get from the programme assistance files the results of the formal evaluations. After this, we developed the case studies in more detail in order to determine our own evaluation of theprogramme interventions. Finally, we compared our evaluations with the results of the formal evaluations done for the funding bodies.
The development of the case studies to carry out our evaluations was as follows. We started analysing the value of the innovation processes. To do so, we used three criteria. First, we assessed the completeness of the innovation processes, specifically if the IS was fully developed and properly used by the SMEs. Second, we considered some further consequences of the SME processes, such as the occurrence of legal problems between the SMEs and their providers. Third, we also explained the social impact of theinnovations given theinformal modification of the scope of action of the programmes by the programme workers, for instance the types of services, the people in charge of the services, and the target SMEs.
We continued the evaluations assessing the assistance processes based on different criteria. For example, if the deliverables were accepted, reversed, or inappropriate, if the deliverables could have been done by the SMEsthemselves, if the SMEs could have directly contracted private suppliers, or if the programme services addressed all the SMEs' needs. Finally, we completed the evaluations of the programme interventions by combining our assessment of the assistance and innovation processes.

3.3 Fieldwork Process

We used numerous methods to gather information. For example, interviews with the SMEs'and programmes'personnel,observation of the use of the IS, internet information about the SMEs and programme organisations, informal conversations with the research participants, as well as the reading of vast material such as economic policy documents, manuals for the management of policies and public funds, policy and funding evaluation reports, programme proposals to access funding, programme reports, and programme assistance files. Of these, the interview was the most important and problematic method.
First of all, interviews were crucial in obtaining the accounts of events, sense-making of the participants, and contexts. The second issue was that the information we wanted to obtain was especially sensitive for the subjects. Most of the SMEs depend on public assistance to accomplish their business initiatives, which may bias their views in favour of

programmes (Lipsky, 1980, 2010; Vega et al., 2008, 2010). With regard to the programme personnel, they may feel the fear of being evaluated by an outsider, so could be motivated to provide biased accounts about their work.Programme evaluation is a politicised area (e.g. Curran et al., 1999; Curran and Storey, 2002; Segerholm, 2003; Stigler, 1971).

We did 27 semi-structured interviews in six SMEs and two programme organizations, using an average of 1 hour 20 minutes for each of them. The programme organisations run different public programmes over time. We use pseudonyms to identify the participant organisations.All the cases were based in England betweenthe years 2002 and 2006.

As expected, in the course of the interviews we realised that part of the information given by the interviewees was biased, e.g. about the use of the IS, the acceptance of pieces of advice, and the attempts to connect the SMEs with other programmes. However, we think that we corrected this situation rapidly given our preparation. Basically, prior to the interviews we had learnt about the policy systems around the programmes, we had read the programmes' scope of action, we had researched the SMEs, and we had read the programme assistance files.

In the interaction with the SME personnel we emphasised that the aim of the research was more to understand SME innovation and improve programme services than to evaluate programmes. Also, we mentioned that as a consequence of the interviews the SMEs could get further support if it were necessary. The conversations were essentially related to the SME innovation processes and not to programme interventions. The issues related to programme interventions were spontaneously emerging throughout the interviews.

The aspect that positively influenced our interaction with the programme personnel was that they knew that we had consciously prepared ourselves for the interviews and that we had already talked in detail with the SME personnel. We believe that this encouraged the programme personnel to explain frankly the pros and cons of the context in which they worked. They even explained deficiencies that were related to them, such as their predisposition to focus on numerical targets and not on quality aspects.

4. CASE STUDY OF CONSTCO

4.1 Programme Organisation ICTASSIST

ICTASSIST is a unit belonging to the departments of Computing and Communications at a university. The programme organisation has been continuously running public-funded programmes for SMEs since its creation in 2002. In fact, ICTASSIST was created to complement the construction of a public-funded building in the university dedicated to knowledge transfer from the mentioned academic departments to businesses.The services delivered by ICTASSIST were related to information and communication technology (ICT). Most of the services were oriented towards ICT SMEs, with the exception of ICT advice and systems design and development, which were standard services to support systems 'adoption' in generic SMEs.The human resource structure of ICTASSIST was composed of a programme manager, project officers for the administration of the services, academics and students for the delivery of the services, as well as third-party service providers for the carrying out of some of the standard services.

4.2 Characteristicsin the Implementation

Many of the programmesimplemented by ICTASSIST had a delayed start, which was caused by the administrative procedures of the funding bodies and the policy administrators that performed the operative tasks on behalf of the funding bodies. In turn, ICTASSIST delayed the recruitment of part of its personnel until the signing of the contracts, which left a reduced time to accomplish the numerical targets.

In the case of the standard services provided to generic SMEs, the range of time given per assistance process was broad, varying from 2 weeks to 4 months, including administrative work and any third-party service provision sub-contracted by the programmes. For example, the design and development of a webpage by an external provider could have taken 2 weeks, and the delivery of a larger and more complex student summer project could have taken 4 months. The programme director commented that one important factor to allocate programme time was the potential contribution of the SME with the outputs.

Also, it seems that the ICTASSIST personnel used a simplistic method to select and service SMEs, and informally refocused the scope of action of the programmespreviously agreed with the policy administrators in order to try to match the requirements of the SMEs. The external auditors did not even mention these changes. The programme manager and a project officer shared similar opinionson these respects.

An important consideration is that many of the SMEs that require support see the programmes of ICTASSIST as their last option to succeed. The programme manager suggested to us take advantage of this situation in order to get the interviews with the SMEs' personnel. There is even a report of ICTASSIST that illustrated the dependency of the SMEs on the public programmes in this way:

> "Many of the companies signposted to [ICTASSIST] were struggling to progress to more effective ICT systems … They were not using systems to their full benefit and in some cases were experiencing major difficulties as a result. A lack of higher-level knowledge and a suspicion of the services of the ICT sector resulted in a number of companies experiencing bottlenecks… In addition, the majority of the companies simply did not have the financial resources or time to invest in ICT development."

The programme manager observed that after the ICTASSIST interventions, the efforts to connect clients with other suppliers largely framed around recommending what should be done from an ICT point of view. Even for ICT subjects, the ICTASSIST personnel did not specify third-party providers in order to avoid responsibility for the quality of any additional work. Similarly, the programme personnel completely distanced themselves from business-related issues. What is more, the programme manager evaded responsibility regarding post-service problems or further SME needs. She blamed any issuearising on the SMEs.

After delivering the services, the university required the SMEs to fill out an internal feedback form on the quality of the services. The questions were about the appropriateness of the diagnosis of the business needs, the level of satisfaction with meetings, printed material, and staff expertise, whether the beneficiary would use the services again or recommend them to others, any issues that particularly impressed or disappointed the beneficiary, as well as an invitation to discuss these issues in person.

4.3 Programme PP-ICTServe

This programme was designed to deliver high level knowledge transfer from the academics of the departments of Computing and Communications to the SMEs of the ICT sector. PP-ICTServe was 50%funded by the EU European Regional development Fund (ERDF) with matched funding from the university. This public funding scheme requires as evaluative targetsa group of numerical indicators, specifically the quantity of SMEs assisted and the increase and safeguarding of jobs and sales.Around six months after the programme interventions, the SMEs' personnel have to fill out a form indicating the increased and safeguarded jobs and sales generated since the end of the assistance.

It is important to mention that if a single business initiative of an SME is assisted by more than one programme, the contribution to the targets for each of them has to be apportioned proportionally to the number of programmes.The policy administration for the ERDF programmes hasnormally been done by the Government Offices for the English Regions.However, the administration and operative tasks of the programmes related to knowledge transfer, including PP-ICTServe, were charged to the North West Universities Association.

4.4 SME and the IS Initiative

The SME assisted by ICTASSIST in this case is referred to as ConstCo. The SME operates as main contractor in the construction sector. At the time of the public assistance, ConstCo had 65 full-time employees and revenues of £8.8 million approximately.

ConstCo used four applications for its service to customers, or front office. There was a package called Conquest for project estimations. Also, the SME used MS Project for the management of projects and AutoCAD for the technical design of construction works. Finally, the SME employed another package called Hire Mate, used for tracking of the physical location of machines, tools, and supplies as well as for the allocation of costs. For the back office, the company employed an accounting package called Intellect. ConstCoalso had an informational website. All the applications ran under a Novell Netware operating system, but some of them used different desktop operating systems and were not integrated. The SME had plans to rent a Virtual Private Network service to allow remote access to the corporate IS for its project site managers.

The SME personnel had two concerns when they initially contacted the people of ICTASSIST. The first was the integration of its technological platforms including security, disaster recovery, and maintainability. The idea was to implement ICTASSIST's advice related to these themes, including new products and processes. The second concern was the improvement of the informational website to be used as a more effective marketing tool.

The SME decided to follow-through on its two initiatives in September 2004. As a result, the programme personnel presented a report on the ConstCo technology platforms in January 2005. Curiously, in August 2006 there was a new approach to ICTASSIST to repeat this service. However, this assistance was not done, at least until the end of 2009. On the other hand, the new website of the company was designed, developed, and put online in May 2005.

4.5 Assistance Process and Deliverables

AfterConstCoand PP-ICTServe made the initial contact, a project officer of the programme was assigned to design the services.The delivery of the assistance was actually commissioned to an external consultant for the technological review and to a third-party service provider for the website work. The advice of the external consultant was given in a report of 3.5 pages. The information to develop this report came from a meeting between the consultant and the IS manager of ConstCo. The report was generic, brief, and without a plan of action. For example:

> "Auditing: Machines can log events such as unsuccessful log on to a system that may be being attacked. Auditing of access to resources and the constant monitoring of these audit trails is a useful and beneficial operation."

The website was completed after some meetings, a review of the old website, some setup, tests, etc. The cost of the public support covered by the ERDF was £656.

After completing with the delivery of the services, the programme personnel did not connect the company with other public or private providers, for instance other programmes, or take any follow-up action on the IS initiatives of ConstCo.

Finally, the EU evaluation form reported the creation of 2 full-time jobs, the safeguarding of 2 full-time jobs, an increase in sales of £210,000, and the safeguarding of sales of £5 million. In addition, the university feedback form was filled out by the managing director, indicating satisfaction with the work of PP-ICTServe.

5. ANALYSIS OF THE CASES

This section uses all the cases in order to strengthen the validity of our findings, as well as to illustrate and explain in detail the differences between the formal evaluations and ours.The programme organisations are called MNGTASSIST and ICTASSIST. The services were delivered by different programmes run by these programme organisations, for example PP-ICTServe. The activity and sector composition of the SMEs is diverse. We use Table 1 to describe the IS initiatives and the services given by the programmes, Table 2 to illustrate the development and outcome of the adoption processes, and Table 3 to contrast our review of the public assistance and the formal evaluations.

SME	IS Initiative	Services Delivered
JVentureCo	A start-up third-party e-marketplace for the building supplies sector	Some marketing and web design consultancy
RecruConstCo	Development of a portal-based, password-protected, self-service application for employers and candidates in the construction sector	Some marketing and business strategy consultancy
RecruTrainCo	Development of an online training forum, improvement of the website's functionality and appearance, and development of further intranet functionality	High level specifications for the forum and website appearance
LanguagesCo	Development of an intranet application to manage the interaction with language service providers and clients	Design and development of the application
FuelCo	Development of a database to compare consumptions of fuel and costs, graphic presentation of the comparisons, and commercialisation of the aggregated comparative data of the fleets. For validity reasons, the data capture of consumption in each truck should be automatic	Design and development of the database and graphic presentation
ConstCo	Improvement of the integrated work of the technological platforms Improvement of the website appearance	Report on the improvement of the technological platforms Design and development of the improvement of the website appearance

Table 1.IS initiatives and programme services

SME	Adoption Process Result	Major Events in the Adoption	Further Outcomes
JVentureCo	Stopped after the implementation stage	Application correctly implemented but poor sales	*The venture was sold given its financial*

		results	*problems*
RecruConstCo	Stopped at the implementation stage	Poor response time of the application, random collapse of the session manager software, and high operation costs	*There were serious legal problems with the service and product providers*
RecruTrainCo	*All the initiatives were successfully completed*	Applications correctly implemented and used by employers, candidates, and employees of RecruTrainCo	The company was offering a more diverse range of services under a new business unit operating structure
LanguagesCo	Stopped and then tried to be restarted at the implementation stage	Pending tasks in the development of the application such as correction of bugs and migration of data	*The production director was trying to modify the company's old application on his own and based on the new design developed by the programme*
FuelCo	The data capture initiative stopped at the planning stage The database and graphic presentation initiatives stopped after the implementation stage	The automatic data capture system was complex and costly to develop. In addition, there was not a critical mass of clients to populate the database Without the data capture system and with few clients, the database did not give any added value in comparison with an old spreadsheet currently used by FuelCo. The database was developed but not used	The company had acquired very few clients and had not offered any aggregated data of the fleets
ConstCo	The technological platform initiative stopped at the planning stage *The website initiative was successfully completed*	The company did not implement the advice because the programme's report was short, general, and with missing parts Website correctly developed and put online	The company asked for a repeat of the report on the technological platforms

Table 2. Development and outcome of the adoption processes

SME	Assistance Process Outcomes	Internal Feedback Form & Public Funding Evaluation
JVentureCo	• Part of the deliverables were not accepted • Part of the deliverables were reversed • Part of the deliverables seem to be inappropriate • Part of the deliverables that were accepted and used couldhave been done by the SME itself • The services were possibly incomplete • Part of the services were for an initiative that was notimplemented • *The services did not correspond to the scope of action of theprogramme*	High satisfaction Increase in sales = £67,000 Jobs created = 2 full-time

RecruConstCo	• Part of the deliverables were not accepted • Part of the deliverables were reversed • Part of the deliverables seem to be inappropriate • Part of the deliverables were already known and used by theSME • Part of the deliverables could have been done by the SMEitself • The services were possibly incomplete • The services were for an initiative that was not implemented	None of the evaluations were completed by the client
RecruTrainCo	• The deliverables were good, accepted, and used • *Part of the services did not correspond to the scope of actionof the programme*	High satisfaction Increase in sales = £225,129 Sales safeguarded = £250,000 Jobs created = 2 full-time Jobs safeguarded = 3 full-time and 1 part-time
LanguagesCo	• Part of the deliverables were reversed • Part of the deliverables seem to be inappropriate • Part of the deliverables were good and accepted, but not used • The services were possibly incomplete • The services were for an initiative that was not implemented • *The services did not correspond to the scope of action of theprogramme*	High satisfaction Increase in sales = 20%
FuelCo	• The deliverables were good and accepted, but not used • The services were possibly incomplete • The services were for an initiative that was not implemented • *The services did not correspond to the scope of action of theprogramme*	High satisfaction The public funding evaluation was not completed by the client
ConstCo	• The deliverables for the technological platforms were not accepted • The deliverables for the technological platforms were incomplete • The deliverables for the technological platforms could have done by the SME itself • The deliverables for the website were good, accepted, andused • All the services could have been contracted by the SMEitself • *The services did not correspond to the scope of action of theprogramme*	Satisfaction Increase in sales = £210,000 Sales safeguarded = £5 million Jobs created = 2 full-time Jobs safeguarded = 2 full-time

Table 3.Assistance outcomes versus formal evaluations

5.1 Evaluation Mechanisms and Power

As showed in the case of ConstCo, the evaluation mechanisms were unreliable and there was a power relationship in favour of ICTASSIST. To begin, the programme evaluation did little to thoroughly investigate the situated quality of the assistance. The opinion of the managing director given in the internal feedback form was very positive, but it did not give details of the completeness either of the service or of the SME initiative. Similarly, the managing director and the IS manager filled out the ERDF evaluation form with impressive numbers. We believe that the attribution of such data to this public programme intervention is difficult to verify. In addition, the programme manager of ICTASSIST mentioned that one relevant criterion in allocating time and designing services to SMEs was their growth plans, which could not be related to the public interventions.

We also suggest that clients may respond positively to evaluation questionnaires in order to ensure the assistance of the programme organisation in the future. Actually, ConstCo and ICTASSIST were arranging a new and more complete service for the technological review, and so the positive evaluations could be a manifestation of a relatively powerful position of the programme workers over the SME. Accordingly, the programme manager and a report of PP-ICTServe mentioned the strong dependency of the SMEs on the public programme.

Poor evaluation mechanisms and power were present in almost the totality of the cases. As mentioned, even the programme personnel of both MNGTASSIST and ICTASSIST were aware of these trends. In fact, we could consider thesecharacteristics as tendencies in the public support to SME innovation (Vega et al., 2010). This is because the most important funding streams rely on similar, or even inferior, evaluation indicators and methods, such as the Regional Development Agency Fund and the Higher Education Innovation Fund, both in England. In addition, the inherent lack of resources in SMEs makes many of them particularly dependent on subsidised support to accomplish their business initiatives, which unbalance the distribution of power against them.

5.2Adoption Results

A core indicator in our analysis is the outcome of the adoption processes that were assisted. We can see in Table 2, in italics in the column titled Adoption Process Result, that *only the initiatives of RecruTrainCo and the website initiative of ConstCo were successfully completed*. In these adoption processes, the applications were correctly implemented and used. The rest of initiatives collapsed at different stages of adoption.

Additional evidence of the poor results of the adoption processes arise from the fact that*some of them not only collapsed, but also generated additional complications and costs to the SMEs*. These complications are described in Table 2, in italics in the column titled Further Outcomes. One clear example was the serious legal problems between RecruConstCo and the service and product providers.

A further criterion to assess the value of the adoptions is given by the level of discretion ofthe programme workers to modify the scope of actionof their programmes (Vega et al., 2012). To start, programmes have to address particular aspects of the economic policy frameworks, for example specific policies, priority sectors, and cross-cutting themesof the Regional Economic Strategies in England. Programmes also have to meet the application criteria of the funds they use, for instancespecific geographical areas and types of supported activities for the ERDF. Finally, programme organisations themselves refine some aspects that differentiate each of them when competing to obtain funding, such astypes of services, subject areas, delivery methods and technologies, target clients, and the use of third-party providers. These three considerations form the scope of action of programmes, which are contractually agreed with the policy administrators.

However, we can appreciate in Table 3, in italics in the column titled Assistance Process Outcomes, that the programme personnel informally modified the scopes of action at the moment of the implementation. For instance, PP-ICTServe was created to provide high level knowledge transfer from academics of the departments of Computing and Communications to ICT SMEs, and not traditional IS services using third-party providers to generic SMEs, as per the assistance given to ConstCo.

In theory, the formulation of the economic policy frameworks and funding application criteria are made following exhaustive procedures, with the participation of experts and interest groups, as well as using empirical evidence and impact studies. We do not suggest that the agreed scopes of action of the programmes are always perfect or offer the best prospects for increasing the welfare of society, but we can infer that the belated improvisation of programme workers has a greater chance of being inappropriate.

Therefore, despite the success of some adoption processes, *the societal value of these completed adoptions could be diminished if we take into account the opportunity cost of not implementing the policies according to the scopes of action set out with the policy administrators*. This statement gives a negative connotation to the overall result of all the adoption processes reviewed in this research.

5.3 Our evaluations versusthe formal evaluations

As the ultimate objective of public support is the value generated by adoption processes, the negative results that we foundare clear indicators of the poor quality of all the public interventions. However, *Table 3, in the column titledInternal Feedback Form & Public Funding Evaluation, illustrates success in almost all the evaluations done by the programme organisations themselves and the formal evaluations done for the funding bodies*.

There is also a strong contrast between the formal evaluations and the review of the assistance processes undertaken by us. This divergence is shown in Table 3. Clearly, *our reviews, which are shown in the column titled Assistance Process Outcomes, denote that most of the public interventions could be questioned from several points of view*. So, the validity of the formal evaluations can be challenged not only on the basis of the results of the adoption processes, but also from many other aspects related to the public interventions themselves.For instance, the review of the assistance toConstCo has five questionable issues.

6. CONSEQUENCES OF FORMAL EVALUATIONS

One factor is that the auditorstook for granted that the outputs reported by SMEs and programme organisations were correct. The auditors only verified the documentation required in the contracts with the policy administrators.The external control of programmes was done measuring the progress of the programmes in terms of targets and financial activities. The problem was that the information to execute the control of a programme was the aggregated information of the auditing activities done for that programme.

To select programmes, the programme organisations submitted proposals describing a set of attributes of their candidate programmes. There are three attributesthat are connected to the outputs reported by SMEs, namely numerical targets, value for society, and history of involvement with industry.However,we have already shown that the results of the programme interventions and their reported outputs are questionable.

The programme directors of MNGTASSIST and ICTASSIST said that the most important procedure to control their programmes was based on a spreadsheet with information about the outputs.A consequence is that public service workerscould tend to prioritise measured activities but reduce attention to qualitative aspects (Wilson, 1968).Additionaly, the decisions of public service workers could be oriented to improve only numerical indicators (Thompson, 1967).

Finally, the aggregated evaluation is done with the analysisof monitoring reports of the economic policy frameworks and funding streams, which are based on aggregated information of all the programmes. However, the problem is thatthis aggregated information was derived from the accumulated data of each programme, and the accumulated data of each programme was based on what was successively reported by SMEs, programme organisations, and auditors.

7. CONCLUSIONS

We demonstrated the relevance of the objectives of the qualitative evaluations. First, weexplained the complex social realm that were assisted and the need of policy interactions. For example, ConstCorequired an action plan for the integration of its technological platforms, needed to select products, services and suppliers, an implementation project, training, requiredto put into operation the new technologies and processes, as well asperiodic maintenance. The SMEsneededto be connected with different public and private providers in order to address several needs in the adoption process stages. Second, we assessed(see Table 3, column assistance process outcomes) the unseen impact of different policy components in terms of acceptance, appropriateness, completeness, usage, etc.

Third, we identified unintended outcomes (see Table 2, column further outcomes) such as the legal problems between an SME and its providers or the costly attempt of an SME to modify its old system based on the unfinished development of a programme. Finally, we illustrated in the case study of ConstCothe uncontrolled practices of programme workers during the selection, design, implementation, connection and follow-up stages of the assistance processes. We even uncovered contextual factors that negatively influence the behaviours of programme workers, specifically evaluation mechanisms, power over the SMEs, and high targets. For example, when the personnel of ICTASSIST selected ConstCo based on its growth plans –and its consequent contribution to the programme targets- and not necessarily on the match between the SME needs and programme capabilities.

We also appreciated that the quantitative approaches to evaluation used by many programmes oriented to SME innovation are not properly applied. Finally, we showed how the take-up of distorted evaluative data at programme intervention level negatively affects thepolicy process.Next, we will explainsome conclusions regarding the entire evaluative practice.

To begin, the funding bodies should use with more caution the targets that are not aligned with innovation(Harrison and Leitch, 1996; Storey, 2006), such as the number of SMEs assisted and the increase and safeguarding of jobs and sales. These indicators could be employed basically to assess additionality. However, the targets should also be connected to the success of the innovation processes, for instance the number of SMEs that properly implemented and use an IS. We saw in the case studies that the SMEs reported excellent increase and safeguarding of jobs and sales but they did not even accomplish their innovation initiatives.

We recommend the formal incorporation of qualitative approaches at the beginning of programmes as formative evaluation and as a basis for the design of future policy initiatives. This should be done as a complement to the employment of proper quantitative approaches (e.g. Curran and Storey, 2002; Lenihan et al., 2007). In particular, qualitative techniques are needed when the areas to be affected by the policies or the policies themselves are relatively unknown, i.e. exploratory evaluation (e.g. Sanderson, 2002), or when the evaluation requires significant participation of different stakeholders, i.e. empowerment evaluation (e.g. McDavid and Hawthorn, 2006).Accordingly, as the problems of poor evaluation mechanisms and power of the programmes over the SMEs seem to be enduring (Vega et al., 2010), we strongly believe that at this point in time the effect of many policies are unknown and that the SMEs should be empowered in the policy process.

Also, the evaluatorsmust not be relatedto the programme organisations orthe policy-making teams, or be contracted by any of these parties. This would avoid the occurrence of conflicts of interests (Curran et al., 1999; Matlay and Addis, 2003; Storey, 2006). In fact, we detected in all the case studiesdifferent kinds of connectionsin the public activity.For instance, the North West Universities Association was administering the ERDF programmes oriented to knowledge transfer activities, which were implementedby university members of this association.So, we suggestthe creation of a unique national evaluation organisation that by its nature could remove any political interference, e.g. a non-departmental public body in the United Kingdom. This organisation could have its own team of evaluators or contract private specialists.

Importantly, we believe that the qualitative evaluations to the programmes oriented towardsSME innovation should be carried out in a similar way as they were done in this research. We showed the effectivity of our approachcorrectly addressing all the qualitative objectives. As explained,the interview was the most relevant and difficult method given the sensitivity of the information for the subjects.We certainlyperceived this problem, but we believe that we corrected it based on a series of actions that wetook before and during the interviews.

Finally, one relevant consequence of the suggested evaluative approach is that the personnel in charge of the evaluations should have an intermediate knowledge of SMEs, business, innovationprocesses, and qualitative interviews.For this reason, the organisations in charge of evaluation should contemplate both the quantitative and qualitative approaches to their work in order to define their human resource strategies.

References

Benbasat, I., Goldstein, D., Mead, M., 1987.The case research strategy in studies of information systems. MIS Quarterly 11(3), 369-386.

Curran, J., 2000. What is small business policy in the UK for? Evaluation and assessing small business policies. International Small Business Journal 18(3), 36-50.

Curran, J., Berney. R., Kuusisto, J., 1999.A Critical Evaluation of Industry SME Support Policies in the United Kingdom and the Republic of Ireland - Stage One Report: Introduction to SME Policies and Their Evaluation. Commissioned by theMinistry of Trade and Industry, Helsinki, Finland.

Curran, J., Blackburn, R., 2001. Researching the Small Enterprise.Sage, London.

Curran, J., Storey, D., 2002. Small business policy in the United Kingdom: The inheritance of the small business service and implications for its future effectiveness. Environment and Planning C: Government and Policy 20(2), 163-177.

Dannreuther, C., 1999. Discrete dialogues and the legitimation of EU SME policy. Journal of European Public Policy 6(3), 436-455.

Davies, P., 2000. Contributions from qualitative research. In: Davies, H., Nutley, S., Smith, P. (Eds.), What Works: Evidence-Based Policy and Practice in Public Services. The Policy Process, Bristol, pp. 291-316.

Greene, F., 2009.Assessing the impact of policy interventions: The influence of evaluation methodology. Environment and Planning C: Government and Policy 27(2), 216-229.

Greene, F., Mole, K., Storey, D., 2007. Three Decades of Enterprise Culture: Entrepreneurship, Economic Regeneration and Public Policy. Palgrave Macmillan: New York.

Harrison, T., Leitch, C., 1996. Whatever you hit call the target: An alternative approach to small business. In: Danson, M. (Ed.), Small Firm Foundation and Regional Economic Development. Routledge, London, pp. 221-247.

Henry, G., Julnes, G., Mark, M., (Eds.) 1998. Realist Evaluation.Jossey Bass, San Francisco.

Johnson, S., 2005. SME support policy: Efficiency, equity, ideology or vote-seeking? In: Proceedings of the 2005 Institute of Small Business and Entrepreneurship (ISBE) conference, Blackpool, UK.

Kasi, M., 2003.Realistic Evaluation in Practice.Sage, London.

Klein, H., Myers, M., 1999.A set of principles for conducting and evaluating interpretive field studies in information systems. MIS Quarterly 23(1), 67-94.

Lee, A., 1989. A scientific methodology for MIS case studies. MIS Quarterly 13(1), 33-52.

Lenihan, H., Hart, M., Roper, S., 2007. Industrial policy evaluation: Theoretical foundations and empirical innovations: New wine in new bottles. International Review of Applied Economics 21(3), 313-319.

Lipsky, M., 1980. Street-Level Bureaucracy: The Dilemmas of Individuals in Public Service. Russell Sage Foundation, New York.
Lipsky, M., 2010. Street-Level Bureaucracy: The Dilemmas of Individuals in Public Service., 2nd edition. Russell Sage Foundation, New York.
Martin, L., Matlay, H., 2001. Blanket approaches to promoting ICT in small firms: Some lessons from the DTI ladder adoption model in the UK. Internet Research 11(5), 399-410.
Matlay, H., Addis, M., 2003. Adoption of ICT and e-commerce in small business: An HEI-based consultancy perspective. Journal of Small Business and Enterprise Development 10(3), 321-335.
McDavid, J., Hawthorn, L., 2006. Program Evaluation and Performance Measurement: An Introduction to Practice. Sage Publications: Thousand Oaks, CA.
Mole, K., 2002. Business advisers impact on SMEs. International Small Business Journal 20(2), 139-162.
Nugent, J., Yhee, S., 2002. Small and medium enterprises in Korea: Achievements, constraints and policy issues. Small Business Economics 18(1-3), 85-119.
Oztel, H., Martin, S., 1998. Local partnership for economic development: Business Links and the restructuring of SME support networks in the United Kingdom. Economic Development Quarterly 12(3), 266-278.
Patton, D., Marlow, S., Ram, M., 2003. Interpretive analysis as an evaluative tool: The case of Mustard.UK.Com, a high-growth small business programme. Environment and Planning C: Government and Policy 21(6), 813-824.
Patton, M., 2002.Qualitative Research and Evaluation third ed. Sage, Thousand Oaks.
Pawson, R., Tilley, N., 1997. Realistic Evaluation.Sage, London.
Popay, J., Williams, G., 1998. Qualitative research and evidence-based healthcare. Journal of the Royal Society of Medicine 191(35), 32-37.
Ramsey, E., Bond, D., 2007. Evaluating public policy formation and support mechanisms for technological innovation. International Review of Applied Economics 21(3), 403-418.
Sanderson, I., 2002. Evaluation, policy learning and evidence-based policy making. Public Administration 80(1), 1-22.
Segerholm, C., 2003. Research evaluation in national (state) politics and administration: A critical approach. American Journal of Evaluation 24(3), 353-372.
Stigler, G., 1971. The economic theory of regulation. Bell Journal of Economics 2(spring), 3-21.
Storey, D., 2000. Six steps to heaven: Evaluating the impact of public policies to support small businesses in developed economies. In: Sexton, D., Landstom, H. (Eds.), The Blackwell Handbook of Entrepreneurship. Blackwell, Oxford, pp. 176-193.
Storey, D., 2006. Evaluating SME policies and programmes: Technical and political dimensions. In: Casson, M., Yeung, B., Basu, A., Wadeson, N. (Eds.), The Oxford Handbook of Entrepreneurship. Oxford University Press, Oxford, pp. 248-278.
Thompson, J., 1967. Organizations in Action. McGraw-Hill, New York.
Tilley, N., Pawson, R., 2001. Realistic evaluation bloodiness. American Journal of Evaluation 22(3), 317-324.
Trochim, W., 1989.Outcome pattern matching and programme theory.Evaluation and Program Planning 12(4), 355-366.
Vega, A., Chiasson, M., Brown, D., 2008. Extending the research agenda on diffusion: The case of public program interventions for the adoption of e-business systems in SMEs. Journal of Information Technology 23(2), 109-117.
Vega, A., Chiasson, M., Brown, D., 2010. The effects of innovation process and programme contexts on the implementation of public services: The worrying case of enterprise innovation. Paper presented at the 14th International Research Society for Public Management (IRSPM) conference, Berne, Switzerland.
Vega, A., Chiasson, M., Brown, D., 2012.Understanding the causes of informal and formal discretion in the delivery of enterprise policies: A multiple case study.' Environment and Planning C: Government and Policy (forthcoming).
Williams, D., 1986. Naturalistic Evaluation (New Directions for Programme Evaluation Series No.30).Jossey-Bass Wiley, San Francisco.
Wilson, J., 1968.Varieties of Policy Behaviour. Harvard University Press, Cambridge.
Yin, R., 2009. Case Study Research: Design and Method fourth ed. Sage, London.

THE IMPROVEMENT OF THE PUBLIC ASSISTANCE TO SMEs: THE ROLE OF GOVERNMENTS, UNIVERSITIES AND INDUSTRY

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Abstract
The objective of this study is to design an approach to investigate the system interventions which could improve the contexts of the public programmes that are aimed at supporting innovation in micro, small, and medium enterprises (SMEs). More specifically, to design and test a theoretical and methodological framework to investigate this concern which could be applied to different contexts, for example developing and developed countries, regions and all economic sectors. The empirical findings of this research highlight the relevant interaction of the core triple helix components, namely governments, universities and industry. We use the street-level bureaucracy (SLB) to understand the context components that in most cases negatively affect public services. To define the interventions we used an adaptation of the diagnostic analysis (DA), which is based on the systems of innovation approach (SIA). We interviewed several policy stakeholders and read substantial secondary material. This study is part of a research programme oriented to the diffusion of information systems in SMEs. We formulated numerous initiatives, for example SME empowerment, market competition simulation for programmes, and consultancy accreditation. The responsibility of improving programme contexts relies on actors that operate outside programme organisations, for instance funding bodies at different levels of government, government departments in charge of SME policies, public-private partnerships, and private evaluators. Given this complexity is that SME associations and universities must strengthen their joint participation in the policy process in order to counteract group interests. The results of this study open a practice-oriented, multidisciplinary, and methodologically pluralist research agenda, which is characterised by the system interventions recommended to improve programme contexts. This research is a novel attempt to use both the SLB and the SIA to study SME policies.

Keywords: SME information systems, enterprise policy, street-level bureaucracy, innovation systems, university and SME association roles

Introduction

Small and medium enterprises (SMEs) are lagging behind their corporate counterparts in the race for the adoption of innovations, for instance information systems (e.g. UNCTAD, 2009; EC, 2010). Governments and economic blocks have been attempting to address this problem with a series of initiatives (e.g. EC, 2005; ECLAC, 2008). An example of public assistance to SMEs is the conventional support delivered by universities and other programme organisations (e.g. Lambert, 2003; Sainsbury, 2007; PACEC/CBR, 2009; HESA, 2010). This conventional support involves one-to-one assistance to SMEs in order to approach specific situations, e.g. the implementation of an information system or the internationalisation of the firm. The services are aimed at applying the results of academic research to particular organisational issues. This can be done, for example, via business advice, consultancy, market research, project management, internet design, and database development.

In the case of universities in the United Kingdom, the practice of conventional support has been consistently increasing in the last decade in line with the constant increase of public funding. According to the Higher Education-Business and Community Interaction Surveys, the income generated by universities from the practice of conventional support increased from £124 million in 2000-2001 to £332 million in 2008-2009 (see HEFCE). The Higher Education-Business and Community Interaction Stakeholders Group has been responsible for defining and commissioning these surveys. The Stakeholders Group calls consultancy to what we identify as conventional support (HESA, 2010, p. 23):

> "Innovative application of existing knowledge (for example across industry sectors) is defined as 'consultancy'. The knowledge itself may not be new, but it can often provide more immediate innovation.

> Indeed, this may be a useful route for the development of ‘open innovation’ practice where intellectual property rights are less important than the usefulness of the knowledge to a particular situation or problem.”

Correspondingly, the Higher Education Funding Council for England commissioned to the Public & Corporate Economic Consultants and the Centre for Business Research of the University of Cambridge a survey to portrait the evolution of the knowledge exchange structure in England. They used their own terminology to define the types of knowledge exchange activities developed by universities. An important indicator of this survey is the percentage of academic staff that has been engaged in knowledge exchange activities related to conventional support. For instance, 35% of the academics were involved in advice and 17% in consultancy in 2008. The report of the survey highlights this increasing tendency as follows (PACEC/CBR, 2009, p. 2):

> “What is striking about the evidence … is the diversity of modes of engagement for knowledge exchange and the fact that significant amount of activity occurs well beyond the traditional ‘technology transfer’ modes of engagement (licensing and spin-outs).”

In general, there have been diverse critics to the support given by some governments to SMEs (e.g. Hoffman et al., 1998; Oztel and Martin, 1998; Storey, 1998, 2006; Bessant, 1999; Dannreuther, 1999; Hadjimanolis, 1999; Kim and Nugent, 1999; Curran, 2000; Martin and Matlay, 2001; Kaufmann and Todtling, 2002; Mole, 2002; Nugent and Yhee, 2002; Johnson, 2005; Chipika and Wilson, 2006; Massa and Testa, 2008; Radas and Bozic, 2009; Vega et al., 2010, 2011).

Accordingly, Lipsky (1980, 2010) states that public services, in general, can be surrounded by harmful contexts. These negative contexts are composed of evaluation mechanisms, power relationships, access to resources, levels of demand, worker alienation, and competing goals. Both, poor evaluation mechanisms and any power of the public organisations over the clients would affect the result of the formal evaluations. These potential misleading results would leave the doors open to public workers to define the level and content of the services. The inherent risk is that any limitation in resources, a low demand for the services, or the existence of alienation in the public workers could make them to opt for public organisation goals instead of social goals when interacting with the clients. Vega et al. (2010) found that in the ambit of SME innovation these harmful contexts can be a trend, and not exceptions to the rule. This confirms similar results over the years in numerous countries in other public service areas such as social services, health, education, legal services, and the police. With this background, we focus the study on the suggestion of activities and actors that could improve programme contexts in the support of SME innovation processes.

The paper starts with the construction of a theoretical framework to perform the research. We use theories from the public administration and innovation areas. After the theoretical work, we explain and extend the method of diagnostic analysis (DA) as a way to organise the research. With the guidance of the theoretical framework and the extended DA, we define the problem, the theoretical base, the underlying system failures, as well as the activities and actors to improve programme contexts. Finally, we explain a series of relevant policy, university, SME associations, and research implications.

Theoretical Framework

To begin, we explain two well-established and contrasting policy implementation theories, namely the street-level bureaucracy (SLB) and new managerialism (NMG), with the aim of discussing the nature and contexts of public services. Based on this discussion we will define a set of factors which affect the choices of public workers. We will use these factors as a departure point for a fine-grained analysis in order to suggest innovation policies to improve public programmes. We also confront the most widely used frameworks to understand innovation and develop innovation policies, namely the systems of innovation approach (SIA) and neoclassical economics (NEC), with the aim of defining the criteria to determine activities and actors to improve programme contexts.

Policy Implementation

The SLB theory (Lipsky, 1980, 2010) explains the nature of the job, context, and behaviour of the workers who interact with the beneficiaries of public services, for instance police officers, judges, and programme consultants. One characteristic in the job of bureaucrats is the significant “discretion” that they use. Discretion may make public workers alter, ignore, extend, or interpret policies, which would imply a change in their role from policy-implementers to policy-makers (e.g. Lindblom and Woodhouse, 1993; Ellis et al., 1999; Maynard-Moody and Musheno, 2003). Discretion can be rooted in the political decisions taken at the highest levels of government. One reason for discretion could be that policy-makers tend to set high targets and provide restricted resources for public services. This makes policy-makers focus the design of the evaluation on numerical indicators related to these political imperatives, and not on the content and quality of the services (e.g. Lipsky, 1980, 2010). Policy-makers could also design extensive and ambiguous policies as a strategy to distance themselves from the consequences of the complicated decisions to balance demand, needs, and resources, which creates room for discretion (e.g. Ellis et al., 1999). Finally, auditors may have conflict of interests given their connection with the policy-making teams or the public organisations, which could make them ignore the evidence of discretion (e.g. Curran et al., 1999; Matlay and Addis, 2003; Storey, 2006).

On the other hand, we have the view of the advocates of a shift in the distribution of power in favour of policy-makers and public managers over bureaucrats. They are the NMG proponents (e.g. Howe, 1991; Jones, 1999; Langan, 2000). According to the NMG, this shift has occurred as a consequence of the centralisation of strategic political direction and the introduction of competition in the delivery of public services. This challenging structure had generated an important cultural change in terms of management responsibilities and supervision. The NMG defenders argue that due to this market-oriented scheme the fundamental drivers of the public service activity are the public policies and procedures, the commands of public managers, the allocation of resources, the evaluative indicators, as well as the statutes and legislation that create both agencies and clients. Therefore, the practice at street level is aligned with a context of political, managerial, and legal authority.

In a multiple case study research, Vega et al. (2012) found excessive discretion and confirmed the causes for this in the ambit of SME innovation policy. Programme workers radically changed the programmes' scope of action that was contractually agreed with the policy administrators, which did not contribute to either the quality of the services or the innovation processes of the SMEs. For this reason, it is important to understand in detail the work context and potentially competing priorities of programme workers, as well as the constraints in controlling their job with conventional mechanisms.

The SLB (Lipsky, 1980, 2010) also states that the contexts of public services tend to be problematic, which affect bureaucrats in the execution of their work. There are six public service components. The first is "evaluation", which embraces the method and data sources used to assess each public intervention. Second, there could be an unbalance of "power" between public workers and clients. The third is the availability of "resources" in terms of time, knowledge, information, and budget. The fourth is the level of "demand" for public services in terms of number of clients, types of services, and time per intervention. Fifth, there could be a probable "alienation" of public workers, which could be caused by the offering of incomplete public services and the disconnection with the rest of each client process. Finally, social, client, or bureaucratic objectives could be in conflict given the existence of competing "goals". Vega et al. (2010) concluded that there is a prevalence of negative contexts in most of the SME innovation policies in the United Kingdom and the European Union systems. There exist widespread and enduring conditions such as political determination of evaluation mechanisms and allocation of resources, SME dependency on external support, as well as lack of awareness in SMEs on innovations and innovation services.

Finally, apart from the work of Vega et al. (2010, 2012), there are very few papers that apply the SLB theory to research enterprise innovation. We have identified only one study that used some SLB concepts to highlight the issue of discretion in a national programme oriented to SMEs (Mole, 2002a). In fact, Johnson (2005, p. 11) stated that "it does not appear that the economic theory of bureaucracy has been utilised explicitly in the analysis of SME policies". In this research, we will use the public service components of the SLB as a starting point for the recommendation of innovation policies oriented to improve programme working conditions. In the following sub-section we discuss the most established frameworks to explain innovation and to develop innovation policies.

Innovation Policy

The SIA (e.g. Freeman, 1987; Lundvall, 1992; Nelson, 1993) was developed on the basis of innovation research and institutional and evolutionary economics (e.g. Lundvall and Borras, 2005). It is also related to general systems theory (e.g. Edquist, 2005). The SIA is a conceptual framework, which includes "all important economic, social, political, organisational, institutional, and other factors that influence the development, diffusion, and use of innovations" (Edquist, 1997, 14). Under the SIA, innovation is defined as an open, interactive, and non-linear learning process (Lundvall, 1992), which is determined by the capabilities (e.g. trust, power distribution, and cooperative relations) and accumulated knowledge in organisations, firm networks, and communities. Reciprocally, the capabilities and accumulated knowledge vary locally as a result of learning trajectories (Asheim and Isaken, 2000). All this complexity creates uncertainty around innovation processes. The SIA uses the concept of "system failure" to explain the malfunctioning of innovation processes, which is the missing or inappropriateness of activities, actors, institutions, or linkages (Edquist, 2002, 2008).

The NEC stance on innovation states that social agents take rational and autonomous decisions among identified outcomes and their values, in order to maximize utility, and aided by complete information. There is the presumption of equilibrium, and that knowledge is created mainly via research and development by one agent and is easily distributed in a linear direction using market transactions. Under the NEC view, the malfunctioning of innovation processes responds to market failures which basically affect the optimum work of agents. The most common policy instruments are economic ones, specifically the protection of the creators of knowledge via intellectual property rights (e.g. Andersen, 2006) and the fostering of competition via agglomeration (e.g. Porter, 1998).

There have been many critics from the SIA side to the innovation stance of NEC. In principle, NEC overlooks that firms behave differently (e.g. Metcalfe and Georghiou, 1998; Lundvall and Borras, 2005) and does not give relevance to the interaction among suppliers, users, competitors, and non-market agents for the development, diffusion, and use of tacit knowledge (e.g. Metcalfe and Georghiou, 1998; Lundvall, 2002; Lundvall and Borras, 2005). This simplified view about innovation processes explains why neoclassical economists have not developed policy instruments to facilitate the interaction among different agents (Edquist et al., 2000; Lundvall and Borras, 2005). In addition, the NEC approach does not take into account the specificities and dynamic characteristics of innovation contexts, hence its notions of optimality and equilibrium are not applicable (Edquist, 2001, 2002). The simplistic view on optimality and equilibrium is the reason why neoclassical economists argue that optimal innovation contexts can be reverse-engineered and replicated in other geographical areas (Storper, 2001).

Vega et al. (2010) confirmed the appropriateness of the SIA. They developed a classification of adoption contexts based on the particularities of the SME adopters, their decision-takers, their micro-environment, as well as the innovations to be adopted. The classification clearly indicates a localised condition of the innovative capabilities and knowledge in SMEs. An additional consideration of the contexts is the multiple dependencies of adoption processes, which implies even further interaction among different agents. The aim of the classification is to explain the variability of adoption contexts, as well as the extent that adoption processes are under the control of the adopters in order to understand their potential for success and the public or private support that could be required. However, to make a more comprehensive use of the SIA we need to study the effects of even more distant activities, actors, institutions, or linkages on the adoption of innovations in SMEs, not only micro-environmental influences and dependent adoptions. We will address this concern studying a further aspect of the system, namely the improvement of public programme contexts.

Approach: Diagnostic Analysis (DA)

Edquist (2002, 2008) defines DA as the sequence to follow in order to design innovation policies. In general terms, DA embraces the identification of a "problem", its associated "system failures", and the determination of the corresponding "policies". A problem should be recognised as a low intensity in a specific system, for example the low diffusion of an information system in the SMEs of a sector. It could be identified via the comparison of systems, for instance the comparison of the levels of adoption of an information system between SMEs of a sector in different regions. The problem must also be an enduring one, in the sense that the market forces could not resolve it by themselves. The following stage is the identification of underlying system failures, which are the causes behind the problem. However, previous to this point of the DA sequence is that we suggest the inclusion of an additional stage, namely the "theoretical base". Our argument is that we cannot research everything in the system in order to identify system failures. For this reason, we need a theoretical base, if there is one, in order to focus the research on specific determinants. With regard to innovation diffusion in SMEs, a good theoretical base could be the classification of adoption contexts developed by Vega et al. (2010).

For example, we could determine that there are some initial barriers for the diffusion of an internet collaborative information system in SMEs, such as the lack of project management skills available for SMEs, the lack of data communication standards to connect different systems, and the lack of trust in the supply chain. They represent SME, innovation, and micro-environmental characteristics, respectively. Moreover, these characteristics denote the existence of complementary adoption processes, e.g. the supply chain partners would have to adopt and connect their internet collaborative information systems too. The identification of barriers and complementary adoptions are relevant entry points to get immersed in the system of innovation in order to identify system failures. For example, the lack of project management skills could be consequence of the lack of relevant consultants in the region, inability to find skilled project management people, or the lack of money to employ them. Similarly, a system failure could be corrected applying several policy instruments. For instance, the lack of relevant consultants in the region could be solved subsidising project management support programmes in universities, redesigning academic courses, or creating consultancy accreditation schemes.

According to Edquist (2005), innovation processes are affected by a series of activities, where some will be more important than others, and they could reinforce or offset one another. He suggests trying to establish a hierarchy of causes, taking into account not only activities, but also the actors that perform them, the institutions that affect them, as well as the linkages among them. Edquist (2001, 2002, 2008) also pointed out that governments and agencies should intervene only if they have the ability to solve or mitigate system failures. The concept of hierarchies and the possible lack of ability to address problems make us think that there could be more to study than the determination of public interventions at one level. Actually, Edquist (2008) emphasises that an initial division of labour between public and private activities is a relevant departure point, but in many cases insufficient to improve innovation processes. We argue that given the possibility of further system failures that could affect the initial policies, the sequence of DA would have to be repeated one or more times. We will exemplify this consideration with the study of a further systemic level, namely public support programmes.

Problem, Theoretical Base, and System Failures

We consider the difficult situation of the contexts of the public programmes in question as the problem. Vega et al. (2010) found that these challenging contexts can affect the work of programmes. They researched this effect in terms of the outcome of the adoption processes in the SMEs and the contributions of the programme services to this, and not via comparison of intensities between different systems. As mentioned, the nature and consequences of these contexts confirm similar results over the years in numerous countries in other public service areas such as social services, health, education, legal services, and the police. The theoretical base is given by the public service components of Lipsky (1980, 2010), i.e. evaluation, power, resources, demand, alienation, and goals. The analysis of Vega et al. (2010) concluded that the difficult situation of the programme contexts was widespread and enduring in most of the United Kingdom and European Union systems.

In general, the explanation of the system failures confirms Lipsky's arguments about contexts and supports the conclusion that these problematic contexts are a tendency. To begin, most of the evaluation methods used by the funding bodies are misdirected. The European Regional Development Fund (ERDF), the Regional Development Agency Fund (RDAF), and the Higher Education Innovation Fund (HEIF) use numerical indicators that do not address either qualitative or content aspects. For example, they focus on number of SMEs assisted or the increase in sales in the SMEs. The attribution of most of these indicators to the programme interventions is questionable and difficult to guess for the owner-managers (Storey, 1998). Clearly, variations in sales and jobs could be consequence of diverse developments not connected to the public support, such as an economic crisis, competitor initiatives, or a new strategy in the SME. Additionally, there could be a conflict of interests created by the connection between the evaluators and either the policy-making teams or the programme organisations. There also exists an inherent imbalance of power in favour of programmes over the SMEs, because SMEs tend to depend on external support to carry out their business initiatives.

The low access to resources could be catalogued as a prevalent situation too. This happens essentially because there is a political imperative at the highest levels of government of providing little resources but setting too ambitious targets to public services (e.g. MacDonald, 1990; Lewis and Glennester, 1996). A potential low demand for the services can be explained by the fact that the programmes are oriented to support innovation processes and, by definition, both the innovations and their associated services are hard to diffuse. A relatively low demand can also be explained by the delayed start of most of the programmes that were approached. This problem is generated by the slow administrative procedures to edit and sign contracts between most of the funding bodies and the programme organisations. Alienation can be a constant risk as well. This can be a consequence of the provision of insufficient resources and the use of poor evaluation mechanisms. Programme workers could feel, with justified reasons, that their work will be incomplete and irrelevant for the SMEs (Lipsky, 1980, 2010). In addition, they could feel, and effectively be, detached from the rest of the SMEs' adoption processes (Lipsky, 1980, 2010). Finally, the dominance of these negative contextual components negatively influences the choice of goals of programme workers, which would be bureaucratic, i.e. programme, goals.

In the next section we finish the cycle of DA oriented to public programmes suggesting a set of policy initiatives to improve the contexts of programmes.

Policies: Activities and Actors

Our DA approach embraces the identification of a problem, a potential theoretical base, system failures, and innovation policies. Having understood the system failures affecting programme contexts, we carried out a study to determine examples of the type of policies which could improve the programme context components. We express these policies in terms of activities and actors. Actually, each recommendation could affect many context components, but we mention only the component that would be more directly affected. For example, the recommendation "adoption and assistance process evaluations" would mostly affect the context component "evaluation", but it could also affect the component "alienation". Note that the context component "goals" is always a consequence of the other components, so it is indirectly addressed by all the recommendations. To accomplish this part of the research we used diverse methods and sources of information, such as interviews to regional policy managers and the managers of different public programmes, reading policy initiatives used in different countries and sectors, various policy implementation manuals, diverse academic studies on the topic, and used some of the previous contributions of our research programme.

As the aim is to improve programme context conditions, we comment on the potential benefits of our recommendations. Also, given the exploratory nature of this part of the study we do not go to the detail of the institutions and systemic linkages that could affect the suggested initiatives. Accordingly, Edquist (2008, 8) emphasised that "[the determination of activities and actors] is a useful departure point for discussing the role of the government in stimulating innovation processes by means of innovation policies". For instance, we suggest that "SME associations" could "improve their participation in the policy process" in order to balance the "power" between programme organisations and SMEs. However, we do not comment on the institutions or systemic linkages that could have been negatively affecting this fundamental role of the SME associations. What is more, SME associations would probably need further complementary policies to properly accomplish some of their functions. In fact, each of our recommendations uncovers a relevant research agenda, which will need to be approached with numerous iterations of DA sequences.

It is important to mention that the correct implementation of some of our recommendations does not guarantee that programmes will operate properly. For example, the correct use of "accredited personnel" could improve the "resources" of programmes, but there could still be problems related to the other programme context components, namely evaluation, power, demand, and alienation. As one might expect, only the right setting up of all the programme context components could ensure the proper operation of public programmes.

Finally, we define the kind of actors with the responsibility of doing these activities. For instance, "the national entity in charge of the SME policies" should require to the programme organisations a general level of specialisation in terms of "sector and functional area focused services". In principle, we name as examples the specific organisations that were performing these roles at the time of writing this paper, i.e. at the beginning of 2011. For instance, the Department for Business, Innovation and Skills was in charge of the SME policies in the United Kingdom in 2011. Clearly, the kind of actor will be always the same but the specific organisation in charge of the activities could change over time and space without affecting the contributions of this study. For example, our research is independent of an eventual merge or split of the Department for Business, Innovation and Skills in the future because there will always be a government department in charge of the SME policies that could require to the programme organisations a general level of specialisation in terms of sector and functional area focused services.

Adoption and Assistance Process Evaluations

This activity is oriented to improve the context component "evaluation". In order to improve the evaluation design, this function should include qualitative approaches as a complement to the proper use of quantitative methods (e.g. Curran and Storey, 2000; Lenihan et al., 2007), the focus should be on the outcomes of the adoption processes of the SMEs as well as on the analysis of each programme action and inaction that could have affected the SME processes. The qualitative evaluations should be employed when it is required the participation of different stakeholders and when the policies or the areas affected by the policies are unknown (e.g. McDavid and Hawthorn, 2006). It is relevant for the evaluators to carry out prior research on the programme, SMEs, and assistance files in order to overcome any bias or inaccurate information given by the SME personnel. This evaluative approach was proposed by Vega et al. (2011). The actors in charge of defining the evaluation design are the funding bodies, e.g. the Directorate-General Regional Policy for the ERDF, Her Majesty's Treasury for the RDAF (to be replaced by the Regional Growth Fund in 2011), and the Higher Education Funding Council for England for the HEIF.

Third-Party Evaluators

This activity is oriented to improve the context component "evaluation". In order to avoid conflict of interests (Curran et al., 1999; Matlay and Addis, 2003; Storey, 2006), evaluators and auditors must not be connected to the policy-making teams or the programme organisations, or contracted by any of these parties. The evaluator organisation could be a non-departmental public body in order to remove any political interference. This organisation could be in charge of evaluating all the programmes oriented towards enterprise innovation. The organisation proposed here could have its own pool of evaluators or contract private specialist companies, for example the Center for Public Program Evaluation (see CPPE) and The Evaluation Partnership (see TEP). The actors in charge of defining the national evaluator should be the funding bodies.

SME Empowerment

This activity is oriented to improve the context component "power". In order to have an influencing presence at all levels and offset other group interests, SME representatives must improve their participation and decision-making in the design, administration, implementation, and evaluation stages of the policy process. After reading the literature, it seems that SMEs have been systematically excluded from the political scenario (Storey, 1994; Coen, 1998; Dannreuther, 1999). For this reason, we believe that the SME associations themselves should be in charge of getting more protagonism in the policy arena. We think that SME empowerment is a pivotal activity in the system of innovation, which would positively affect all the other recommendations to improve programme contexts and in general SME policy.

Market Competition Simulation for Programmes

This activity is oriented to improve the context component “power”. In order to avoid the dependency of SMEs on a single programme organisation, more than one programme organisation should offer similar services in the same geographical area. Vega et al. (2010) found evidence that in some cases this does not happen. The selection process of programmes should take into account not only the appropriateness of individual programmes but also the balance of the total regional support. The political actors responsible for proposing this general competitive environment should be the European Union and national entities in charge of SME policies, e.g. the department of SMEs and Entrepreneurship of the Directorate-General Enterprise and Industry and the Enterprise Directorate of the Department for Business, Innovation, and Skills, respectively. However, the implementation of this rule must be in charge of the funding bodies and their regional delegates who perform the operative tasks, i.e. the policy administrators. Some examples of the regional delegates are the Government Offices for the English Regions (to be dismantled in 2011) for the Directorate-General Regional Policy, the Regional Development Agencies (to be replaced by the Local Enterprise Partnerships in 2012) for Her Majesty’s Treasury, as well as the Regional Teams for the Higher Education Funding Council for England.

Sector and Functional Area Focused Services

This activity is oriented to improve the context component “resources”. In order to get experience and knowledge, programme organisations should continually deliver services to the same sectors and functional areas. The selection process of programmes should contemplate this requirement. Accordingly, Martin and Matlay (2001) expressed the need of a more discriminated approach in the United Kingdom government support to information systems innovation in SMEs. The political actors responsible for proposing this general level of specialisation in the programme organisations should be the European Union and national entities in charge of SME policies. However, the implementation of this requirement must be in charge of the funding bodies and their regional delegates.

Professional Accreditation

This activity is oriented to improve the context component “resources”. In order to acquire experience and knowledge, programme organisations could opt to work with accredited personnel (Morgan et al., 2006). Accreditation is a professional certification awarded by an expert body, which is aimed at endorsing a certain level of knowledge and experience of people or organisations on a given subject. To get accredited, a practitioner is assessed in terms of past performance and theory. Programme organisations can accredit their practices if they have a minimum number of accredited employees. Accreditations focus on continual professional development, for which it is necessary periodic re-accreditations. The actors that are in charge of awarding accreditations can be organisations created by industry such as the Institute of Business Consulting (see IBC), or public-private partnerships such as Technology Means Business (see TMB). Technology Means Business was specifically created for the accreditation on information systems for SMEs. The initiator, one of the founders, and main public partner of Technology Means Business was the E-commerce Ministry of the Department of Trade and Industry, subsequently part of the Department for Business, Enterprise and Regulatory Reform, and now a role of the Department for Business, Innovation, and Skills.

Awareness Campaigns

This activity is oriented to improve the context component “demand”. In order to increase the demand in SMEs for specific innovations and their associated programme services, the suite of innovation policies should include awareness campaigns (Papazafeiropoulou et al., 2002; Beckinsale et al., 2006). The actors in charge of this inclusion are the partnerships that formulate the integrated economic frameworks. Some relevant examples of the integrated economic frameworks are the Regional and Sub-Regional Economic Strategies required by the United Kingdom government and the Single Programming Documents required by the European Union. For instance, the Regional Development Agencies have been taking the leadership role for the development of the Regional Economic Strategies. The Regional Development Agencies have special units that were in charge of specific innovations, for example the Directorate of Enterprise of the Northwest Regional Development Agency had an Information and Communications Technology unit as coordinator for all the information systems policies in the region. So, the labour of this kind of units is central for the development of particular and structured information systems policy strategies.

Simplification of Contractual Procedures
This activity is oriented to improve the context component “demand”. In order to start programme operations on time and have better chances to reach targets, the procedures to edit and sign contracts between the funding bodies and the programme organisations must be shortened. Vega et al. (2010) found evidence of delays of many months, even more than a year, in all the ERDF and RDAF funded programmes that were approached in the fieldwork. This administrative issue makes it worse the effect of the inherent low demand for services oriented to innovations. The actors in charge of doing this process reengineering are the funding bodies, specifically the Directorate-General Regional Policy and Her Majesty’s Treasury. However, the actors that negotiate the contracts on behalf of the funding bodies are their regional delegates.

More Comprehensive Set of Services
This activity is oriented to improve the context component “alienation”. In order to make programme workers participate more in each SME adoption process, programmes should deliver services that cover most of the SME needs. For instance, the programme services could embrace strategic assessment, planning of the implementation, selection of providers, design and development of information systems, as well as training in the use of the systems. Chapman et al. (2000) and Wolcott et al. (2008) proposed a similar end-to-end approach. The selection process of programmes should include this criterion. The political actors responsible for proposing this general range of services should be the European Union and national entities in charge of SME policies. However, the implementation of this requirement must be in charge of the funding bodies and their regional delegates.

Modification and Reduction of Numerical Targets
This activity is oriented to improve the context component “alienation”. In order to make programme workers participate more in each SME adoption process, the targets must be more qualitative and any numerical indicator must be reasonably ambitious. As explained, qualitative targets would be more connected to the success of the entire SME adoption processes as well as to the actions and inactions of the programme workers. Apart from that, a reduction of the magnitude of the numerical targets would automatically increase the time and other resources that could be assigned to individual interventions. This is a matter of understanding productivity in public service provision (Hamilton, 1972). The political actors responsible for proposing these general evaluative modifications should be the European Union and national entities in charge of SME policies as well as the funding bodies.

Conclusions
Apart from the use of a novel multidisciplinary theoretical framework and the extension of the DA approach to determine innovation policies in different contexts (e.g. developed and developing countries, regions and all economic sectors), this study presents a series of relevant contributions. To start, the responsibility for the improvement of programme contexts relies on numerous actors, which are located outside programme organisations. For example, European Union and national funding bodies, private evaluators, SME associations, European Union Directorates-General and government departments in charge of SME policies, Local Enterprise Partnerships, and public-private partnerships. Programme organisations could develop some activities to try to improve their operative levels, for example, strategies of personnel selection and development, programme marketing, as well as performance appraisal and reward management. However, even in these situations programmes still depend on the system.

In fact, if the system allocates low levels of funds to the programmes, programme organisations will not be able to implement any meaningful initiative to improve context conditions, e.g. personnel selection and development strategies to improve human resources. A similar effect has the challenging numerical targets set for the programmes. If the targets are higher, the level of resources allocated to each intervention will be reduced. The combined effect of little funds and high targets is even more problematic. Another case of the dependency on the system is manifested with the marketing strategies that could be developed by programme organisations in order to increase the demand. These initiatives will do little if the system does not work properly in terms of the awareness of innovations. As a final example, even fine-grained programme strategies of performance appraisal and reward management to control alienation will be impracticable if the system continues misdirecting the evaluative indicators.

To complicate things, all of our recommendations clearly depend on political decisions. The clearest examples are the modification of the evaluative design, the creation of an independent evaluator organisation, the empowerment of SMEs, the market competition simulation for programmes, and the modification and reduction of numerical targets. In addition to many public organisations at different levels of government there are numerous interest groups, such as universities, programme organisations, private evaluators, professional bodies, as well as private service and product suppliers, which could have different objectives over time. In general, the interests of this complex network of actors and their relative power make the work of reforming the provision of public services an especially difficult task. For this reason, I suggest using the "political economy" framework to research the systems of innovation for the public support to SMEs, above all at the highest levels of government (e.g. Dannreuther, 1999, 2007).

Under this complexity is that we see one of our recommendations to improve programme contexts as critical, namely "SME empowerment". SME associations must act by themselves given the long-lasting failure of the political forces to effectively include them in the policy process. The improved participation of SME associations throughout the policy process could counterbalance the political and group interests with the technical view of the beneficiaries of the public services (Storey, 1994; Coen, 1998; Dannreuther, 1999). In fact, a proper political participation plays an enormous role in the empowerment of groups (e.g. Deneulin and Shahani, 2009). For example, this involvement is vital in the policy process stage of evaluation, which is a highly politicised practice (e.g. Curran et al., 1999; Curran and Storey, 2000; Segerholm, 2003). Accordingly, empowerment or participatory approaches to policy evaluation contemplates the involvement of different stakeholders, including the recipients of services (e.g. McDavid and Hawthorn, 2006). We believe that SME associations should improve their participation not only in the evaluation, but also in the design, administration, and implementation of public policies.

As mentioned, there could be many factors impacting a proper participation of SME associations in the policy process, for example the preponderance of big corporations (Coen, 1998), a persistent disorganisation in the SME sector as well as legal frameworks that frustrate SME policy (Danreuther, 1999). However, we consider that there is a crucial aspect to mobilise the SME sector, namely "knowledge". We consider that "universities" have the relevant role of disseminating to the "SME associations" the results of the research on the outcomes of SME innovation, the value of public programmes, and on the contextual components that impact both innovation processes and programmes. In fact, this could be a new type of knowledge exchange activity in universities. This responsibility is even more compelling taking into account that universities are in charge of part of the SME policy process.

Consequently, Massa and Testa (2008) argues that there has been a long-lasting "misalignment" between SMEs, academics, and policy-makers in terms of concepts, indicators, institutional roles, goals, and policy mechanisms. These differing assumptions have been nurtured by the confusion created by numerous "mythical concepts" about the nature and factors that influence SME activities, for example the multiple definitions of a growth SME and the causalities of growth (Gibb, 2000). In fact, this would have produced the establishment of misguided policy priorities. Gibb (2000, p. 30) believes that a relevant initiative to get adequate consensus in SME matters should be the increase and improvement of the interaction between academics and different stakeholders, especially SMEs:

> "As the process of 'government' changes to one of 'governance', then there is opportunity for academics to recognise more fully the way in which policy emerges and turn their attention more closely to the perceived priorities and the explicit and implicit assumptions that underpin these. There will be a need to understand the theories that SMEs have about their own behaviour and the way that stakeholders seek to explain their behaviour. This will involve the academic in being more closely involved in the community and with the growing number of private/public government agencies or small firms associations."

Probably, an initial action to materialise this interaction could be the reorientation of part of the sponsorship of the research done in universities from government agencies to SME associations. For example, Rogers (2003, p. 118) illustrated in this way the effect of the sources of sponsorship on diffusion research:

> "A source of bias is a tendency for diffusion research to side with the change agencies that promote innovations rather than with the individuals who are potential adopters … One cannot help but wonder how the diffusion research approach might have been different if the Ryan and Gross (1943) hybrid corn study had been sponsored by the Iowa Farm Bureau Federation (a farmer's organisation) rather than by the Iowa Agricultural Experiment Station. What if the Columbia University drug study had been sponsored by the American Medical Association rather than by the Pfizer Drug Company? The source of sponsorship of early diffusion studies may have been given these investigations not only a pro-innovation bias but also structured the nature of diffusion research in other important ways."

Finally, the SIA and the DA used in this study open a multidisciplinary and methodologically pluralist research agenda on SME innovation. Our recommendations to improve programme contexts are examples and therefore there should be more activities that could improve these contexts. All the possible recommendations should be affected by their own set of institutions and should be linked to other activities in the system. So, the cycle of DA could be required in multiple instances for each recommendation. In addition, the diffusion of information systems in SMEs is directly affected by more than just public programmes. There are other determinants such as the diffusion of complementary innovations, the development of information systems in application service provider technology, the setup of fiscal, legal, and regulatory frameworks to trade online, power in the supply chain, trust among business partners, and the development of leadership and innovativeness in SMEs. The research of all the determinants that directly affect SME innovation, not only public programmes, should be extended under the conceptual base of the SIA and the DA in order to give a deeper and relevant value to practice.

References

Andersen, B. (Ed.) (2006), *Intellectual Property Rights: Innovation, Governance, and the Institutional Environment*, Edward Elgar Publishing Limited, Cheltenham.

Asheim, B. and Isaken, A. (2000), "Localised knowledge, interactive learning and innovation: Between regional networks and global corporations", in Taylor, E. and Taylor, M. (Eds), *The Networked Firm in a Global World: Small Firms in New Environments*, Ashgate Publishing Group, Aldershot, pp. 163-198.

Beckinsale, M. and Ram, M. (2006), "Delivering ICT to ethnic minority businesses: An action-research approach", *Environment and Planning C: Government and Policy*, Vol. 24, No. 6, pp. 847-867.

Bessant, J. (1999), "The rise and fall of 'supernet': A case study of technology transfer policy for smaller firms", *Research Policy*, Vol. 28, No. 6, pp. 601-614.

Business Link, "Solutions for Business", Department for Business, Innovation, and Skills, London, website at: http://www.businesslink.gov.uk/bdotg/action/aboutus?lang=en&page=AboutUs&r.s=h (accessed 15 December 2010).

Chapman, P., James-Moore, M., Szeczygiel, M. and Thompson, D. (2000), "Building internet capabilities in SMEs", *Logistics Information Management*, Vol. 13, No. 6, pp. 353-361.

Chipika, S. and Wilson, G. (2006), "Enabling technological learning among light engineering SMEs in Zimbawe through networking", *Technovation*, Vol. 26, No. 8, pp. 969-979.

Coen, C. (1998), "The European interest and the nation state: Large-firm lobbying in the European Union and member states", *Journal of Public Policy*, Vol.18, No. 1, pp. 75-100.

CPPE, "Promoting Excellence in Public Service", Center for Public Program Evaluation, Virginia, USA, website at: http://evaluationcenter.net/default.aspx (accessed 10 December 2008).

Curran, J. (2000), "What is small business policy in the UK for? Evaluation and assessing small business policies", *International Small Business Journal*, Vol. 18, No. 3, pp. 36-50.

Curran, J., Berney, R. and Kuusisto, J. (1999), "A critical evaluation of industry SME support policies in the United Kingdom and the republic of Ireland - Stage One Report: Introduction to SME Policies and Their Evaluation", commissioned by the Ministry of Trade and Industry, Helsinki, Finland.

Curran, J. and Storey, D. (2000), "Small business policy: Past experiences and future directions". Paper presented at the SME Seminar Series: Linking Research and Policy, Small Business Service, 12 December, London, UK, available at: http://business.kingston.ac.uk/research/kbssbs/currstor.pdf (accessed 27 December 2005).

Dannreuther, C. (1999), "Discrete dialogues and the legitimation of EU SME policy", *Journal of European Public Policy*, Vol. 6, No. 3, pp. 436-455.

Dannreuther, C. (2007), "A zeal for a zeal? SME policy and the political economy of the EU", *Comparative European Politics*, Vol. 5, No. 4, pp. 377-399.

Deneulin, S. and Shahani, L. (Eds) (2009), *An introduction to the human development and capability approach: Freedom and agency*, Earthscan Publications Ltd, Sterling VA.

DTI (2003), "Single programme appraisal guidance", Department of Trade and Industry, London, available at: http://www.bis.gov.uk/files/file11686.pdf (accessed at 25 December 2010).

EC (2005), "i2010 – A European information society for growth and employment", European Commission, DG Information Society and Media, Brussels, available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2005:0229:FIN:EN:PDF (accessed 10 Jan 2010).

EC (2010), "ICT and e-business for an innovative and sustainable economy – 7th synthesis report of the sectoral e-business watch", European Commission, DG Enterprise and Industry, Brussels, available at: http://www.ebusiness-watch.org/key_reports/documents/EBR09-10.pdf (accessed 10 March 2010).

ECLAC (2008), "San Salvador commitment: Plan of action eLAC 2010", Economic Commission for Latin America and the Caribbean, Santiago, available at: http://www.eclac.cl/socinfo/noticias/noticias/3/32363/2008-2-TICs-San_Salvador_Commitment.pdf (accessed 5 February 2010).

Edquist, C. (1997), "Systems of innovation approaches: Their emergence and characteristics", in Edquist, C. (Ed.), *Systems of Innovation: Technologies, Institutions and Organizations*, Pinter: London, pp. 1-35.

Edquist, C. (2001), "The systems of innovation approach and innovation policy: An account of the state of the art", Lead paper presented at the Danish Research Unit for Industrial Dynamics (DRUID) conference, 12-15 June, Aalborg, Denmark, available at: http://www.druid.dk/conferences/nw/paper1/edquist.pdf (accessed 4 September 2007).

Edquist, C. (2002), “Innovation policy – A systemic approach”, in Archibugi, D. and Lundvall, B. (Eds), *The Globalizing Learning Economy*, Oxford University Press, Oxford, pp. 219-238.

Edquist, C. (2005), “Systems of innovation: Perspectives and challenges”, in Fagerberg, J., Mowery, D. and Nelson, R. (Eds), *The Oxford Handbook of Innovation*, Oxford University Press, Oxford, pp. 181-208.

Edquist, C. (2008), “Design of Innovation Policy Through Diagnostic Analysis: Identification of Systemic Problems (or Failures)”, working paper, Centre for Innovation, Research and Competence in the Learning Economy, Lund University, Lund, 26 November, available at: http://circle-lund.net/UploadedPublications/200806Edquist.pdf (accessed 15 November 2009).

Edquist, C., Hommen, L. and Tsipouri, L. (Eds) (2000), *Public Technology Procurement: Theory, Evidence, and Policy*, Kluwer Academic Publishers, Boston.

Ellis, K., Davis, A. and Rummery, K. (1999), “Needs assessment, street-level bureaucracy and the new community care”, *Social Policy and Administration*, Vol. 33, No. 3, pp. 262-280.

Freeman, C. (1987), *Technology Policy and Economic Performance: Lessons from Japan*, Pinter, London.

Gibb, A. (2000), “SME policy, academic research and the growth of ignorance, mythical concepts, myths, assumptions, rituals and confusions”, *International Small Business Journal*, Vol. 18, No. 3, pp. 13-35.

Hadjimanolis, A. (1999), “Barriers to innovation for SMEs in a small less developed country (Cyprus)”, *Technovation*, Vol. 19, No. 9, pp. 561-570.

Hamilton, E. (1972), “Productivity: The New York city approach”, *Public Administration Review*, Vol. 32, No. 6, pp. 784-795.

Hoffman, K., Parejo, M., Bessant, J. and Perren, L. (1998), “Small firms, R&D, technology and innovation in the UK: A literature review”, *Technovation*, Vol. 18, No. 1, pp. 39-55.

HEFCE, “Higher Education-Business and Community Interaction Survey”, Higher Education Funding Council for England, London, UK, website at: http://www.hefce.ac.uk/econsoc/buscom/hebci/ (accessed 5 December 2010).

HESA (Higher Education Statistics Agency) (2010), “Higher education-business and community interaction survey 2008-2009”, commissioned by the Higher Education-Business and Community Interaction Stakeholders Group, London, available at: http://www.hefce.ac.uk/pubs/hefce/2010/10_14/10_14.pdf (accessed 5 December 2010).

Howe, D. (1991), “Knowledge, power and the shape of social work practice”, in Davies, M. (Ed.), *The Sociology of Social Work*, Routledge, London, pp. 202-220.

IBC, “Enhancing Performance”, Institute of Business Consulting, London, UK, website at: http://www.ibconsulting.org.uk/ (accessed 25 April 2010).

Johnson, S. (2005), “SME support policy: Efficiency, equity, ideology or vote-seeking?”, paper presented at the 28th Institute of Small Business and Entrepreneurship conference, 2-4 November, Blackpool, UK, available at: http://160.9.128.65/lbs/pri/G1%20Johnson%20(010)R%20FINAL.doc (accessed 15 August 2009).

Jones, C. (1999), “Social work: Regulation and managerialism”, in Exworthy, M. and Halford, S. (Eds) *Professionals and the New Managerialism in Public Services*, Open University Press, Buckingham, chapter 4.

Kaufmann, A., Todtling, F. (2002), “How effective is innovation support for SMEs? An analysis of the region of Upper Austria”, *Technovation*, Vol. 22, No. 3, pp. 147-159.

Kim, L. and Nugent, J. (1999), “Korean SMEs and their support systems”, in Levy, B., Berry, A. and Nugent, J. (Eds), *Fulfilling the Export Potential of Small and Medium Firms*, Kluwer Academic Publishers, Boston. Cited in Nugent, J. and Yhee, S. (2002), “Small and medium enterprises in Korea: Achievements, constraints and policy issues”, *Small Business Economics*, Vol. 18, No. 1-3, pp. 85-119.

Langan, M. (2000), “Social services: Managing the third way”, in Clarke, J., Gewirtz, S. and McLaughlin, E. (Eds), *New Managerialism, New Welfare?*, Sage, London, pp. 152-168.

Lambert, R. (2003), “Lambert review of business-university collaboration” commissioned by the HM Treasury, London, available at: http://www.hm-treasury.gov.uk/d/lambert_review_final_450.pdf (accessed 15 January 2010).

Lenihan, H., Hart, M. and Roper, S. (2007), “Industrial policy evaluation: Theoretical foundations and empirical innovations: New wine in new bottles”, *International Review of Applied Economics*, Vol. 21, No. 3, pp. 313-319.

Lewis, J. and Glennerster, H. (1996), *Implementing the New Community Care*, Open University Press, Buckingham.

Lindblom, C. and Woodhouse, E. (1993), *The Policy-Making Process*, 3rd edition, Prentice Hall, New Jersey.

Lispky, M. (1980), *Street-Level Bureaucracy: The Dilemmas of Individuals in Public Service*, Russell Sage Foundation, New York.

Lispky, M. (2010), *Street-Level Bureaucracy: The Dilemmas of Individuals in Public Service*, 2nd edition, Russell Sage Foundation, New York.

Lundvall, B. (1992), *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*, Pinter, London.

Lundvall, B. (2002), "Innovation policy in the globalizing learning economy", in Archibugi, D. and Lundvall, B. (Eds), *The Globalizing Learning Economy*, Oxford University Press, Oxford, pp. 273-291.

Lundvall, B. and Borras, S. (2005), "Science, technology and innovation policy", in Fagerberg, J., Mowery, D. and Nelson, R. (Eds), *The Oxford Handbook of Innovation*, Oxford University Press, Oxford, pp. 599-631.

Macdonald, G. (1990), "Allocating blame in social work", *British Journal of Social Work*, Vol. 20, No. 6, pp. 525-546.

Martin, L. and Matlay, H. (2001), "Blanket approaches to promoting ICT in small firms: Some lessons from the DTI ladder adoption model in the UK", *Internet Research*, Vol. 11, No. 5, pp. 399-410.

Massa, S. and Testa, S. (2008), "Innovation and SMEs: Misaligned perspectives and goals among entrepreneurs, academics and policy makers", *Technovation*, Vol. 28, No. 7, pp. 393-407.

Matlay, H. and Addis, M. (2003), "Adoption of ICT and e-commerce in small business: An HEI-based consultancy perspective", *Journal of Small Business and Enterprise Development*, Vol. 10, No. 3, pp. 321-335.

Maynard-Moody, S. and Musheno, M. (2003), Cops, Teachers, Counsellors: Stories from the Front Lines of Public Service. University of Michigan Press: Ann Arbor.

McDavid, J. and Hawthorn, L. (2006). Program Evaluation and Performance Measurement: An Introduction to Practice. Sage Publications: Thousand Oaks, CA.

Metcalfe, S. and Georghiou, L. (1998), "Equilibrium and evolutionary foundations of technology policy", *Science, Technology, and Industry Review (Organisation for Economic Co-Operation and Development)*, Vol. 22, No. 1, pp. 75-100.

Mole, K. (2002), "Business advisers impact on SMEs", *International Small Business Journal*, Vol. 20, No. 2, pp. 139-162.

Mole, K. (2002a), "Street-level technocracy in UK small business support: Business links, personal business advisers and the small business service", *Environment and Planning C: Government and Policy*, Vol. 20, No. 2, pp. 179-94.

Morgan, A., Colebourne, D. and Thomas, B. (2006), "The development of ICT advisers for SME businesses: An innovative approach", *Technovation*, Vol. 26, No. 8, pp. 980-987.

Nelson, R. (Ed.) (1993), *National Innovation Systems: A Comparative Study*, Oxford University Press, Oxford.

Nugent, J. and Yhee, S. (2002), "Small and medium enterprises in Korea: Achievements, constraints and policy issues", *Small Business Economics*, Vol. 18, No. 1-3, pp. 85-119.

Oztel, H. and Martin, S. (1998), "Local partnership for economic development: Business links and the restructuring of SME support networks in the United Kingdom", *Economic Development Quarterly*, Vol. 12, No. 3, pp. 266-278.

PACEC/CBR (Public & Corporate Economic Consultants and The Centre for Business Research) (2009), "The evolution of the infrastructure of the knowledge exchange system", commissioned by the Higher Education Funding Council for England, London, available at: http://www.pacec.co.uk/documents/Evolution%20of%20Infrastructure%20of%20KE%20System%20-%20Full%20Report.pdf (accessed 5 December 2010).

Papazafeiropoulou, A., Pouloudi, A. and Doukidis, G. (2002), "A framework for best practices in electronic commerce awareness creation", *Business Process Management Journal*, Vol. 8, No. 3, pp. 233-244.

Porter, M. (1998), "Clusters and the new economics of competition", *Harvard Business Review*, November-December, pp. 77-90.

Radas, S. and Bozic, L. (2009), "The antecedents of SME innovativeness in an emerging transition economy", *Technovation*, Vol. 29, No. 6-7, pp. 438-450.

Rogers, E. (2003), *Diffusion of Innovations*, Diffusion of Innovations, 5th edition, Free Press, New York.

Sainsbury, D. (2007), "The race to the top: A review of government's science and innovation policies", commissioned by the HM Treasury, London, available at: http://webarchive.nationalarchives.gov.uk/+/http://www.hm-treasury.gov.uk/d/sainsbury_review051007.pdf (accessed 25 February 2010).

Segerholm, C. (2003), "Research evaluation in national (state) politics and administration: A critical approach", *American Journal of Evaluation*, Vol. 24, No. 3, pp. 353-372.

Storey, D. (1994), *Understanding the Small Business Sector*, Thomson Learning: Andover.

Storey, D. (1998), "Six steps to heaven: Evaluating the impact of public policies to support small business in developed countries", working paper, Centre for Small and Medium-sized Enterprises, Warwick University, Coventry, September.

Storey, D. (2006), “Evaluating SME policies and programmes: Technical and political dimensions”, in Casson, M., Yeung, B., Basu, A. and Wadeson, N. (Eds), *The Oxford Handbook of Entrepreneurship*, Oxford University Press, New York, pp. 248-278.

Storper, M. (2001), “Regional technology policies in Europe: TSER research projects, 1998-2000”, *in the proceedings of the workshop on the Regional Level of Implementation of Innovation Policies, European Commission, Brussels, Belgium, 23-24 November,* pp. 147-170, available at ftp://ftp.cordis.europa.eu/pub/improving/docs/ser_regional_policies.pdf (accessed 10 November 2008).

TEP, “The Evaluation Partnership”, The Evaluation Partnership, Surrey, UK, website at: http://www.evaluationpartnership.com/ (accessed 15 February 2010).

TMB, “Raising the Standards for Information and Communications Technologies”, Technology Means Business, London, UK, website at: http://www.tmb.org.uk (accessed 5 January 2010).

UNCTAD (2009), “Information economy report 2009 - trends and outlook in turbulent times”, United Nations Conference on Trade and Development, New York and Geneva, available at: http://www.unctad.org/en/docs/ier2009_en.pdf (accessed 15 March 2010).

Vega, A., Chiasson, M. and Brown, D. (2010), “The effects of innovation process and programme contexts on the implementation of public services: The worrying case of enterprise innovation”, paper presented at the 14th International Research Society for Public Management (IRSPM) conference, 9-7 April, Berne, Switzerland, available at: http://www.irspm2010.com/workshops/papers/G_theeffectsofinnovation.pdf

Vega, A., Chiasson, M. and Brown, D. (2011), “A revisited performance impact of the public assistance to SME innovation: Policy consequences and a complementary evaluative approach”, paper presented at the 15th International Research Society for Public Management (IRSPM) conference, 11-13 April, Dublin, Ireland.

Vega, A., Chiasson, M. and Brown, D. (2012). “Understanding the causes of informal and formal discretion in the delivery of enterprise policies: A multiple case study”, *Environment and Planning C: Government and Policy* (forthcoming).

Wolcott, P., Kamal, H. and Qureshi, S. (2008), “Meeting the challenges of ICT adoption by micro-enterprises”, *Journal of Enterprise Information Management*, Vol. 21, No. 6, pp. 616-632.

ROLE OF INTERMEDIARIES IN ACCELERATING THE TRANSFORMATION OF INTER-FIRM NETWORKS INTO TRIPLE HELIX NETWORKS: A CASE STUDY OF SME-BASED INDUSTRIES IN THAILAND

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Abstract
This paper explores the roles innovation intermediaries play in stimulating triple helix networks in Thai SMEs. Typically, knowledge networks can be classified into three forms: vertical value chain; horizontal/industrial chain; and diagonal/triple helix networks. The first two inter-firm networks evolve into triple helix network upon policy intervention via intermediaries. Intermediaries play sponsoring role at policy level by channeling resources to industry; brokering role at strategic level by linking triple helix actors; and boundary spanning role at operational level by providing services that facilitate knowledge circulation. Data were collected from the ceramic and furniture industries to test the significance of the ways the triple helix process is intermediated. The sponsoring role of intermediaries is found to be crucial for promoting the development of triple helix network in the case of these industries. The experiences of the two cases further suggest that market-led intermediaries would be more effective in promoting triple helix network development than government-funded intermediaries.

Keywords: Intermediaries; Triple helix network; SMEs; Ceramic industry; Furniture industry; Thailand

THE SMALL AND MEDIUM BUSINESS CLUSTER GROWTH MODEL

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Abstract
Program development of The Small and Medium Business has been cultivated for a time more focused, harmonious and sustainable among industry groups,basic industry / industry upstream, various industries (downstream) and small industry, without favor one industry group because each has a role, "share" and the nature of the adhesions. One approach to develop The Small and Medium Business deemed successful is through a group approach. In the group approach, the support (both technical and financial) distributed to the group rather than per individual or units. Groups believed to be a better approach because (1) The Small and Medium Business usually can not afford individually capture market opportunities and (2) Business networks are formed proved to effectively enhance the competitiveness of businesses because it can synergize. For donor support, the group approach is also better because the process of identification and empowerment The Small and Medium Business become more focused and efficient.
Model or approach the concept of the nomenclature of the group in question is one of them is a cluster. The concept of the cluster in general can be interpreted as a kind of grouping a set of economic activities with clear linkages and interconnected both vertically and horizontally without being limited by location or region. So The Small and Medium Business Cluster can no longer be viewed as a small industrial centers as common as in general, but in addition emphasis on localization or demographic status is also more emphasis on the agglomeration of companies that form strategic partnerships and complementary as well as having an intense relationship. The results of the analysis conducted on The Small and Medium Business in Ciamis District shows that The Small and Medium Business effectively composed of three groups (The Small and Medium Business Effectively I, The Small and Medium Business Effectivelly II and The Small and Medium Business Effectively III). The Small and Medium Business Cluster in Ciamis District to be managed in an integrated manner based on social forces, political, economic, cultural and government. The Small and Medium Business in Ciamis District can be developed and upgraded to a more advanced so that The Small and Medium Business that provide superior value for both Ciamis District and can be a trigger or driver of the other economic actors.
By Seeing the potential Strengths, Weaknesses, Opportunities and Threats The Small and Medium Business activities in Ciamis District of strategies can be done to anticipate the weaknesses and threats by relying on and empowering potential and opportunities that will give birth to clusters of The Small and Medium Business which will bear the potential of them are better so give a good effect also for other aspects.

Keywords: small and medium business, cluster, Growth model

I.INTRODUCTION

1.1. Background

Program development of Small and Medium Enterprises (SMEs) has been cultivated for a time more focused, harmonious and sustainable among industry groups; (basic industry / industry upstream), miscellaneous industries (downstream) and small industries, without favor one industry group, because each has a role, "share" and the nature of the attachment. That difference should be not an obstacle, but it is a capital to grow and develop diversified industries, because not all production activities can be implemented efficiently and effectively through a large-scale enterprises. It is important to face the era of free trade are encouraged to race competitively in the process of industrialization. Facts prove the toughness of the SME business during the economic crisis, which at the time the SME Businesses are able to move, even as an alternative to the Selah community in tackling the economic crisis.

Business Importance of SMEs in developing economies in developing countries has been realized and recognized by development economists.

Home Industry (domestic industry), small industries and medium industries are grouped in the SME business has contributed to a significant and large in providing employment and income for the people of Indonesia. SME business is always designated as a key sector in employment creation, distribution and close association with local resources, so the business potential of SMEs in promoting rural economic development. Therefore, empowerment and sustainable development needs to be done so that SMEs are not only growing in number but growing in quality and competitiveness of its products. One approach to developing a successful business that is considered is through a group approach. In the approach, the support (both technical and financial) to the business channeled the creative industries are not per individual / unit. Groups believed to be a better approach because (1) Business individually usually less quickly capture market opportunities and (2) business networks are formed proved to effectively enhance the competitiveness of the business because it can synergize with each other. For donor support, the group approach is also better because the process of identifying and empowering the business to be more focused and efficient. Model / concept of the approach of the nomenclature of the group mentioned above is one of them is a cluster. Cluster is defined as the number of companies and institutions that are concentrated in a region, and are interconnected in a specialized field that supports competition (Michael E. Porter, 1998). Cluster region is limited by linkage and complementary and should not be limited by administrative region.

Model / concept of the approach of the nomenclature of the group mentioned above is one of them is a cluster. The concept of the cluster (Cluster) itself can generally be defined as a grouping of a series of similar economic activity with clear linkages and interconnected both vertically and horizontally without being limited by location or region. So that clusters of SMEs Business can no longer be viewed as common as the smaller industrial centers in general, but in addition to emphasis on the localization or demographic status, too much emphasis on the agglomeration of companies that form strategic partnerships and complementary and have an intense relationship. Ciamis Regency is an area that has high economic potential include food and beverage industries based on agriculture, which has a distinctive product, thus becoming one of the Ciamis Regency main products, including industry, crackers, brown sugar etc.

Business Development of SMEs in accordance with local economic potential and natural resources owned by Ciamis District is one of the policy defined by the Ciamis Regency in the Regional Medium Term Development Plan (RPJMD) Ciamis Regency Year 2009-2014 are listed in one of the development mission Ciamis Regency in 2009 - ¬ 2014 is "Creating the regional economy and a strong community-based, competitive local seed potential". In connection with, the activities of the preparation of the SME Business Cluster Growth Model, especially in food and beverage industry based on agriculture in Ciamis Regency is needed as one basis for planning the development of small and medium scale industries, which can provide recommendations on support to enhance the growth of food and beverage industry based on agriculture to be more advanced and independent.

1.2. Research Objectives

The purpose of this activities are:

1) Assess the business growth of the food and beverage industries are agriculture-based and are moving toward a stronger competitive edge;

2) Selection of food and beverage industry with potential farm-based cluster

3) Establish the dominant factor affecting the growth of food and beverage industries based on agriculture;

4) Develop a business cluster model of food and beverage industries based on agriculture.

1.3. The Importance of Research

Given the results of this activity is to be gained are as follows:

1. Able to help those who need the information related to industrial, food and beverage industry cluster-based agriculture.

2. Can be used as the basis for the government in the Ciamis District Establishing a Business Model Cluster growth of agriculture-based food and beverage

I.LITERTURE REVIEW

2.1 Definition of Clusters

According to Porter (1998) Clusters are geographic concentrations of companies and institutions that are interconnected in a particular sector. Because they are associated together and complement each other. Clusters drive the industry to compete with each other. Apart from industry, government and the cluster includes industries that provide support services such as training, education, information, research and technology support. Meanwhile, according to Schmitz (1997) cluster is defined as a group of companies that gather in one location and work in the same sector. While Enright, M, J, 1992 defines a cluster as the companies are similar / same or related to each other, come together in a certain geographic boundaries. Definition of clusters (JICA, 2004) can also be defined as the geographic concentration of related industries and institutions-institutions. Cluster developments have reduced the importance of geographical proximity, therefore, be flexible depending on the geographic boundaries of the importance.

Ministry of Cooperatives and SMEs as written in the book Empowering SMEs through Empowerment of Human Resources and Business Cluster, showing understanding of the cluster as a group activity that consists of a core industry, related industries, supporting industries, and economic activities (sectors) and other related support, that the activities be interrelated and mutually supportive.

Marshall, emphasized the importance of the three types of external savings that led to the industrial district: (1) The concentration of skilled workers, (2) berdekatannya specialist suppliers, and (3) the availability of facilities to gain knowledge. The existence of the number of skilled workers in large numbers facilitate saving himself from the labor side. Location adjacent to the suppliers who produce savings due to specialization that emerged from the widespread occurrence of the division of labor between firms in the activities and processes that complement each other. Availability of facilities to acquire the knowledge shown to increase the savings due to information and communication through shared processes, inventions and improvements in machinery, processes and organization in general. Becattini, defines the industrial district as a social area which is characterized by the existence of human communities and companies, and both tend to unity. Empirical studies show that the industrial centers in the practice in various countries can be classified according to: (1) Institutional Structure, (2) The ownership, (3) Adult or New Cluster.

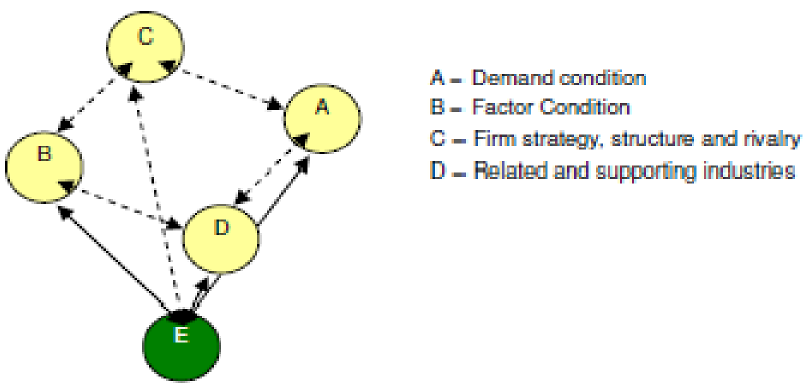
2.2 Cluster formation

Theoretically, the centers / clusters are formed because of two things: (1) Historical factors and (2) factors Notching / manipulation. These two factors will form two types of clusters: (1) Cluster of Adult and (2) New Cluster. Adult cluster typically formed when a region / city has a lot of craftsmen, in the city, will initially form a cluster Artisanal. For one reason or another, this cluster is able to survive through time and attract others to support their activities. The emergence of industrial clusters begins when the parties appeared willing to be a supplier of specialized input for the artisanal clusters. If the cluster Adults emerge in a "natural". Then the emergence of cluster shape is due to deliberate government or other institutions who wish to form a cluster. Clusters formed are often referred to as the New Cluster since its inception tended to be younger age than traditional clusters that exist today.

2.3 Synergies in Cluster

Synergy or cooperation between members of clusters of course based on the economic and financial factors. Review of the literature indicates that at least three types of savings that could result from the synergy of members in a particular cluster, namely: (1) The concentration of skilled workers, (2) The contrentration specialist suppliers, and (3) the availability of facilities to gain knowledge.The existence of the number of skilled workers in large numbers facilitate the saving of the labor force. Location adjacent to the suppliers who produce savings due to specialization that emerged from the widespread occurrence of the division of labor between firms in the activities and processes that complement each other. Availability of facilities to acquire the knowledge shown to increase the savings due to information and communication through shared processes, inventions and improvements in machinery, processes and organization in general.

Porter's view of the cluster is the most widely cited in studies were found. "A consequence of the system of [diamond] determinants is that? A nation's competitive industries are not spread evenly through the economy but are connected in what I term clusters consisting of industries related by links of Various Kinds" (Porter, 1990). Despite Porter's cluster is clearly not mendefinisikasi but he has been connected between the performance of a country in the global economy are summarized in the word "competitiveness" of the cluster. This concept emerged after he observed the 16 clusters that play an important role in economic development in his study in 1990 although at that time, he has not given a great emphasis on problem clusters.
According to Porter, competitiveness is formed by the interaction of several factors known as factor "diamond". Diamond is formed by (1) factor condition, (2) demand conditions, (3) related and supporting industries, and (4) firm strategy, structure and rivalry. He also included two factors related context indirectly through: (1) the role of chance and (2) role of government. These factors dynamically affect the company's competitive position in a country. "Competitive advantage in advanced industries is increasingly determined by differential knowledge, skills and innovation rates of the which are embodied in skilled people and organizational routines" (Porter, 1990) The relationship of these factors may show a pattern cluster, where the relationship between Business (and organizations) should support the achievement of competitive advantage.



Formation and consolidation of social capital becomes a core element in the strengthening of clusters. This cluster of social capital as the internal bonds will bridge the relationship with external parties. Indonesia is recommended for this condition are:
In the cluster active - dynamic, linkage of these five factors will shape the diamond model of Porter's value chain (value chain) is strong. As an illustration of a mechanism within the context of a value chain of industrial clusters, such as the establishment of a relationship with a new market will lead to the formation of a group of producers (SME) that specializes in logistics and sales activities.

2.4 Determinants Cluster Development

Growers cluster development, as defined by Michael Porter (1998), contains four determinants or diamond known as the model that leads to industrial competitiveness, namely: (1) input factor (factor / input condition), (2) demand conditions (demand condition), (3) supporting and related industries (related and supporting industries), and (4) strategy of the company and its competitors (and context for firm strategy). There are an explanation of the model of Porter's diamond:

1). Input factors

Porter input factors in the analysis are variables that already exist and are owned by a cluster of industries such as human resources (human resources), capital (capital resources), physical infrastructure (physical infrastructure), infrastructure information (information infrastructure), infrastructure, science and technology (scientific and technological infrastructure), infrastructure administration (administrative infrastructure), and natural resources. The higher the quality factor of this input, the greater the chances industries to increase competitiveness and productivity.

2). Demand Conditions
According to the diamond model of demand conditions associated with the sophisticated and demanding local customers. The more advanced a society and increasingly demanding customers in the country, then the industry will always strive to improve the quality of products or to innovate in order to meet the desires of local customers are high. But with globalization, demand conditions not only from local but also from overseas.

3). Supporting and Related Industries
The existence of supporting and related industries will improve the efficiency and synergy in Clusters. Synergies and efficiencies can be created, especially in transaction costs, sharing of technology, information and specific skills that can be utilized by industry or other companies. Another benefit is related supporting industries and the creation of competitiveness and increased productivity.

4). Corporate Strategy and competition
Corporate strategy and competition in the diamond models are also important because these conditions would motivate a company or industry to constantly improve the quality of the products and are always looking for new innovations. With healthy competition, companies will always find a suitable new strategies and trying to always improve efficiency. Best (1999) and then develop further arguments put forward models of Porter and dynamic clusters as illustrated in figure 2.5. Best models can explain the process in the evolution of a cluster that is not transformed into a dynamic active. The process is:

a.. Various companies produce similar commodities in the cluster. The emergence of a dynamic company which resulted in innovation and technology diffusion
b. When many companies competing to develop production capabilities, technical variations in the cluster grows
c.. While companies seek to increase production capacity through specialization, they need a partner who can support, so that new business opportunities timbulah each company specializes in a particular production process while continuing to enhance the capabilities of technology.

111. DESCRIPTION INDUSTRY IN CIAMIS REGERENCY

Development of industry in Ciamis Regency showed that the better conditions in order to support the regional economy. Type of industry developed mainly agricultural raw materials such as wood processing, animal feed, handicrafts, processed foods, palm oil, coconut coir processing, tapioca, and so forth. The results of a wood processing industry, fish and shrimp, coconut flour, bamboo crafts / wood, processed foods, some of which have been exported.
Industry is available in Ciamis Regency consists of Leather Industry, Wood Industry, Metal, Industrial Matting, Industrial Pottery, Industrial Fabrics, Food and Beverage Industry. Most types of industries in Ciamis Regency of the food and drinks as much as 25 675 units. While the number of other industries are as many as 8237 units of woven industry, wood industry as many as 1193 units, as many as 372 units of industrial fabrics, and pottery industries as many as 193 units.

Based on the food and beverage industry spreading ever found in Pangandaran District (3101 units) and Purwadadi District (9800 units). Industrial matting is widely available in Rajadesa District(4290 units) and Panumbangan District(658 units). For more shall clearly see Table 1. The industrial sector provides hope for economic growth in the future Ciamis Regency. This is indicated by the growth of new industries that can provide significant employment opportunities for the community Ciamis District. In order to anticipate developments that will occur should be pursued repsentatif space provision, so that conflicts can be anticipated space. On this basis, the allocation of space for such industry is directed at a location that has access to the southern ring road (Cijeungjing and Ciamis District).

Conditions that existed at the site has grown to several industrial activities as a forerunner to the establishment of zones / industrial estates in the region.

Table 1.
Number of Industrial Distribution Per District in Ciamis Regency in 2007

No.	Sub District	Leather Industry	Timber Industry	Metal Industry	Matting Industry	Pottery Industry	Cloth Industry	Food and Beverage Industry
1	Cimerak	0	7	0	15	0	0	869
2	Cijulang	0	2	0	57	25	0	162
3	Cigugur	0	65	0	24	0	30	610
4	Langkaplancar	0	5	0	0	61	0	162
5	Parigi	3	14	0	35	22	14	745
6	Sidamulih	0	18	0	42	0	0	1.131
7	Pangandaran	0	17	0	3	7	0	3.101
8	Kalipucang	0	43	1	2	0	0	2.521
9	Padaherang	0	33	0	10	0	11	85
10	Banjarsari	1	94	5	276	1	0	1.871
11	Lakbok	1	47	0	17	6	70	1.126
12	Pamarican	0	55	2	18	3	8	78
13	Cidolog	0	25	0	56	0	16	94
14	Cimaragas	0	11	4	9	20	8	32
15	Cijeungjing	0	53	1	243	16	51	0
16	Cisaga	0	58	0	41	0	0	77
17	Tambaksari	0	16	0	10	0	0	91
18	Rancah	0	77	0	279	0	6	195
19	Rajadesa	0	115	0	4.290	0	0	339
20	Sukadana	0	36	2	36	0	10	42
21	Ciamis	0	20	0	17	0	42	632
22	Cikoneng	1	33	1	152	6	0	585
23	Cihaurbeuti	0	12	0	11	22	2	87
24	Sadananya	0	22	13	620	0	1	152
25	Cipaku	0	33	1	16	1	0	100
26	Jatinagara	3	15	0	419	0	0	11
27	Panawangan	3	96	0	549	0	17	509
28	Kawali	0	18	0	14	0	3	85
29	Panjalu	0	30	0	286	0	0	79
30	Panumbangan	1	31	0	658	0	9	169
31	Sindangkasih	0	5	0	3	3	0	4
32	Baregbeg	0	43	6	13	0	5	47
33	Lumbung	0	15	0	5	0	0	45
34	Purwadadi	0	3	0	6	0	69	9.800
35	Mangunjaya	0	10	0	0	0	0	13
36	Sukamantri	0	16	0	5	0	0	26
Total		**13**	**1.193**	**36**	**8.237**	**193**	**372**	**25.675**

IV. RESEARCH METHODOLOGY

4.1. Desaign Research

As is well known that the main objective of this research is the formulation of structured SME Business Cluster Growth Model (the food and Beverage industry) are effective in Ciamis Regency. Assessing the growth of industrial centers that exist and are moving toward a stronger competitiveness; Establish the dominant factor affecting the growth of business clusters of SMEs so as to provide recommendations to the Government in this case the Ciamis Regency Office of Industry and Commerce in an effort to develop a cluster of SMEs, especially in industry agriculture-based food and beverage.

- Phase I (Identification Condition SMEs)
  At this early stage identification of the activities carried out concerning the condition of the profile of existing SME food business in Ciamis Regency viewed from several aspects of both quantitative and qualitative, including the type, amount, supply of raw materials, production capacity, marketing, quantity and quality of product, investment, and other assets. Information gathering activities performed by collecting data from the Department of Industry and Trade of Ciamis Regency (Disperindag), Central Bureau of Statistics (BPS), and the results of research studies have been done before.
  The results of this first phase of identification of SMEs in the sectors of agriculture-based food and beverages available in Ciamis Regency.

- Phase II (Analysis of Current Conditions)
  At this stage, activities define and create the criteria, set the variable operational Business Cluster Growth Model of SMEs in the sector of agriculture-based food and beverages. The concept of Cluster Growth Model Business SMEs in the sector of agriculture-based food and beverage is approached from the definition and criteria of the cluster, so that the SMEs in the sectors of food and beverages can be classified based agriculture has the potential to be a cluster, the factors that influence the formation of clusters. In the phase II study was supported by the literature review the theoretical foundation for understanding the cluster center for SMEs and Business SMEs in the sectors of agriculture-based food and beverages; parameters and indicators for measuring the development of both centers and the cluster of studies in the country and study abroad; as well as finding the center of the cluster model of growth that could theoretically be used as a comparison with the reality of the growth centers of the observed clusters of SMEs.
  Based on predetermined criteria such data processing was performed using multiple analysis tools. The process of phase II is expected to determine the SME food and beverage industry that can potentially serve as a driving force (champion) or as a main supporting member or complementary.

- Phase III (Assessment of SME Clusters)
  At this stage the potential of SMEs assessed the food and beverage industry in Ciamis Regency where the location of the escalation that has a high growth area, where SMEs Business centralized location, how far the contribution of SME business at the location of local and regional development. The results of this process which can be known, the type and number of clusters that may or allow formed and cultivated.
  Map results could determine the sampling technique to be used, whether by way of a random, stratified method / petala, and / or purposive.

- Phase IV (Survey)
  Survey stage is the stage of data collection is needed, so the rules are met and the adequacy of the data requirements so that work can be justified scientifically. Prior to the survey predetermined unit of analysis, respondents and sampling techniques.
  Broadly speaking, the required data is secondary data and primary data.

- Phase V (Data Processing)
  At this stage V of data collected in the survey, and after verified and then processed and analyzed using appropriate analytical tools, such as descriptive analysis, R / C, analysis of competitiveness.

- Phase VI (discussion / seminar)
  At this stage to discuss the results of the analysis and data processing, alternative form of the model cluster.

- Phase VII (Preparation of the Final Report)
  At this stage the team completed the job with the complete lack of stage VI and include suggestions and recommendations

4.2 Method Of Analysis

Data collected are classified by categories of compliance with the dynamic characteristics of the cluster and center. Further data were tabulated based on the classification assigned. Tabulation of the results of re-checking is then performed to ensure the accuracy presentation. Data is processed in a spreadsheet so you can easily do further processing with a variety of other statistical applications programs.

Some of the methods used in this study is:

1.Descriptive Statistical Analysis.

Descriptive analysis remains a lot of analysis that will be used throughout this study. Data were processed and presented in the form of frequency distributions, cross tabulations, is presented based on similar characteristics or compared to understand the phenomenon of contrast, or treated to be easily used for the processing of descriptive statistical analysis and inferential statistics.

2. R / C Analysis

One concept that can measure the success rate of SMEs is by using the analytical balance between revenues and expenditures (R / C or the Revenue Cost Ratio). If the ratio is the number greater than 1 then the SMEs are said to be beneficial and may continue cultivated, and vice versa if the number is smaller than 1, then SMEs are at a loss. The higher value of R / C means the greater the revenue that the entrepreneurs of every dollar spent. Thus R / C is high reflecting the more profitable production processes. (Abbas Tjakrawiralaksana, 1983). According Anwas Adiwilaga (1974), states that to see the success rate of SMEs can be seen from the magnitude of R / C, with the following formula:

$$R/C = \frac{\text{Revenue}}{\text{Cost}}$$

3. Competitiveness analysis.

Factor and discriminant analysis is used to draw the line between success and perceived clusters that failed to develop into business clusters. This analysis gives information about the knowledge of the dominant factors that support successful business cluster development of SMEs.

Y (competitiveness) = X1 (product prices), X2 (product quality), X3 (Packaging), X4 (marketing)

V.RESULTS AND DISCUSSION

5.1 Industry Grouping

In this study sought SMEs in the sector of food and drinks that can adequately represent the competencies and is an excellent product. SME product range is vast in Ciamis Regency, among other processed food products and beverages based on agriculture and plantation.

5.2 The Potential SMEs

From the analysis has to be determined on SMEs in the food and beverage industry is the potential that exist in Ciamis Regency. Selected group of SMEs which can be viewed in Table 2

Table 2.

The Potential of food and beverage industry SMEs in Ciamis Regency, 2011

No	Type's SMEs	Location
1	Sale & Snack	Bunisinga, Sukamaju
2	Patries	Pasirjengkol, Banjarsari
3	Salted Fish	Pangandaran
4	Coconut Sugar	Cikalong
5	Palm Sugar	Sukamanah, Sindangkasih
6	Crackers	Sindangsari, Cikoneng
7	Rangginang Roll	Paledah

Source: Results of Analysis, 2011

5.3 The Prospective SMEs

After going through the previous stages, we then performed staging or determination of the prospective SMEs as expected from this activity. So effective SME are:

Table 3.

The Prospective SMEs in Ciamis Regency base on R/C Analysis, 2011

No	UKM
1	Crackers, Coconut Sugar
2	Patries, Falm Sugar, Salted Fish
3	Rangginang, Banana sale

Source: Results of Analysis, 2011

5.4 The Competitiveness SMEs

For SMEs which have the competitiveness of the various SMEs in Ciamis Regency of the grouping, assessment or analysis has found that SME competitiveness is quite high, namely:

Table 4.

The Competitiveness SMEs in the Ciamis Regency, 2011

No	SMEs	Location
1	Banana Sale	Bunisinga, Sukamaju
2	Patries	Pasirjengkol, Banjarsari
3	Crackers	Sindangsari, Cikoneng
4	Coconut Sugar	Cikalong, Ciamis
5	Salted Fish	Pangandaran, Ciamis

Source: Results of Analysis, 2011

5.5 The Effective SMEs

Business cluster growth model is effective in Ciamis Regency are as follows.

Table 5.

The Effective Cluster Model

No	The Prospective SMEs	The Competitiveness SMEs	The Effective SMEs
1	Crackers, Coconut Sugar	Falm Sugar, rangginang, Coconut Sugar	Coconut Sugar, Crackers
2	Patries, Falm Sugar, Salted Fish	Patries, Crackers, Salted Fish	Salted Fish, Patries
3	Rangginang, Banana sale	Banana Sale	Banana sale

Source: Results of Analysis, 2011

5.5.1 The Effective Business Cluster Growth Model 1

The business model of cluster growth 1 are effective in Ciamis Regency are as follows

Table 6.

The Effective Business Cluster Growth Model 1

No	The Effective SMEs	Type Cluster	Location
1	Coconut Sugar	Food and Beverage Industries	Kec. Sidamulih
2	Crackers	Food and Beverage Industries	Kec. Cikoneng

Source: Results of Analysis, 2011

a. **Coconut Sugar**

Coconut Comodity is one that has economic value. One way of managing the coconut so that it can provide significant added value is made by tapping the sap of palm sugar is a liquid that comes out of Mayang coconut (the coconut / coconut flowers).

District of Sidamulih in Ciamis Regency of West Java is the most Productivity, in various sectors, home industry or cottage industry managed independently by the head of the family. The average population is almost routine every day to produce palm sugar. In the palm sugar industry activities in Sidamulih District is done through a miraculous process. A brief description of the process of Sidamulih District namely:

- The first process before it becomes sugar, which must be done, tap water or take the sap of coconut flowers tankai, which is already installed from morning to evening, every day 2 times to climb in the morning and afternoon,

- Once collected then cooked and thickened and molded into palm sugar. After this stage of making palm sugar, then immediately sold through agents or collectors. Palm sugar industry as one of the effective cluster flying businesses in Ciamis Regency where the next is how to maintain this industry in order to be a palm sugar-producing areas with more capacity and be of good commodities with better management anymore.

The growth of business clusters of palm sugar in Ciamis Regency, located in Sidamulih District, network marketing to local markets (Traditional market, modern market) is quite extensive inter-island although there are but few in number.

b. Crackers

District of Cikoneng is one of West Java district of Ciamis Regency Productivity, in various sectors, home industry or cottage industry managed independently by the head of the family. Home industry is the cracker industry that has become a center for a long time and have become hereditary.

In this study, the cracker industry in the district was selected as one of the effective cluster flying businesses in Ciamis Regency where the next is how to maintain this industry in order to become an industrial cluster locations cracker with a capacity of more and be a good commodity to the management better. The growth of business clusters crackers in Ciamis Regency, located in Cikoneng District, network marketing to local markets (Market Traditional, modern market) is quite extensive inter-island although there are but few in number.

Table 7.

The Effective Business Cluster Growth Model 2

No	The Effective SMEs	Type Cluster	Location
1	Salted Fish	Food and Beverage Industries	Kec. Pangandaran
2	Patrries	Food and Beverage Industries	Kec. Banjarsari

Source: Results of Analysis, 2011

a. Salted Fish

Fish sauce is one of the basic necessities to supplement the diet. The need for salted fish is quite high and needed by various segments of society from grassroots communities and vice versa. In Pangandaran District of salted fish production is quite high and has become the center so that the presence of salt fish industry has become one of the economic value in commodity of Pangandaran District

Salted fish activity is located in the District of Pangandaran is famous enough. Because in addition to production and the quality is good, the location of salted fish industry is strategically located on Pangandaran beach resort area that has been widely known by community. The presence of salt fish industry in this Pangandaran District of raw materials not only from his own district Pagandaran. However, coming from outside the District of Pangandaran either from outside the province and in the provinces. This is because raw materials is determined by the season, fish / sea conditions and the conditions of existence of the fish itself. The presence of salt fish industry is located in Pangandaran District is to remain one of leading commodities for Ciamis Regency it needs to be maintained and enhanced from various sector.

b. Pastries

In District businesses or business Banjarsari cookies long enough and wide enough range of marketing was up to the outer islands. Business pastries is enough to prove that its existence is quite superior as a mainstay commodity Ciamis Regency. Judging from the amount of employment enough in terms of both quality and quantity.

The operations of these cookies that are located in the District of Banjarsari and production quality value is good enough. Thus the existence of this pastry industry must be maintained and improved even better than the various aspects in order to remain one of leading commodities for Ciamis Regency.

Table 8
The Effective Business Cluster Growth Model 3

No	The Effective SMEs	Type Cluster	Location
1	Banana Sale	Food and Beverage Industries	Kec. Mangunjaya

Source: Results of Analysis, 2011

a. Banana Sale
Sale of business activities located in the District of Mangunjaya an activity that is a mainstay in his district alone. This is evidenced by the activities of the population is predominantly located in the banana business sale.
Thus the sale of industrial enterprises in Mangunjaya District is one of the food industry has a significant economic value. Bananas for sale business is not just selling products, but also promote the quality, reliability and customer satisfaction. In addition to the sale of the banana industry to provide business opportunities or employment opportunities particularly for local communities.
From the results of the study, that the industrial activities that have significant growth including the sale of bananas, including industrial clusters and food industry can be a cluster that already has a pretty good business potential to be developed in order to stay afloat, sustainable, efficient and a good member benefits. Growth of the banana Sale in Mangunjaya District, network marketing to local markets (Traditional Market, modern market) in Ciamis Regency more inter-island although there are but few in number while their raw materials come from within his own district, outside the district and even outside the province because of the need for raw materials is sometimes difficult to obtain in their own territory. So with the sale of industrial activity needs to be a banana is an attempt to survive and its activities can be useful again.

VI.CONCLUSION AND RECOMMEDATIONS
6.1 Conclusion
Development of food and beverage industries (SMEs) in Ciamis Regency in demand should be sustained so that is no longer seen as a regular industry in general. So with tersusunya SME Business Cluster Growth Model Ciamis Regency can improve, maintain and create an independent SMEs, powerful, advanced and sustainable.
The results of the analysis conducted in Ciamis Regency has determined the cluster idustri effective food and drink that consists of three groups (I Effective SMBs, SMEs and SME effective effective II III). Furthermore, set out SME Business Cluster Growth Model Ciamis Regency are diversifying demands of SMEs Cluster in Ciamis Regency to be managed in an integrated manner based on social forces, political, economic, cultural and government. SMEs in Ciamis Regency can be developed and upgraded to a more advanced, more organized and more organized SMEs to be clustered and well-managed and sustainable. In a sense after the election of some SMEs according to the results of the study, how the effort to improve, develop, and maintain the selected SMEs as SMEs cluster in order to be effective one that delivers superior value for both the Ciamis Regency and can be a trigger or driver of the other economic agents .
Then from these activities can also be used as a tool to deliver a variety of assumptions and hypotheses and the development of SMEs in particular an increase in food and beverage industry in Ciamis Regency theoretically and conceptually.

6.2 Recommendations

To trigger the food and beverage industry SMEs have the potential effective and programs relating to the SME industry in an integrated and comprehensive. Between sectors and across sectors in an integrated and work together to jointly develop the potential of SMEs in Ciamis District.
Ciamis Regency has good potential for a lot of historical, cultural, social, economic and industrial sediri, who qualified in industrial development. For it in developing an effective SME Business clusters in Ciamis Regency must be considered as the responsibility for the advancement of industry in Ciamis Regency. Crafts industrial heritage or protected, maintained and developed so that it can survive and sustainable. Modernization of production equipment or machinery must be integrated with the engine hallmark trdisional in Ciamis Regency This gives a positive contribution to the field of other aspects such as the field of tourism.

DAFTAR PUSTAKA

Aidil Juzar, (2006),Model Strategi Pengembangan Klaster Unggulan Menggunakan Kompetisi Inti Daerah Kabupaten dan Kelembagaannya, Disertasi, Sekolah Pascasarjana IPB.

Deni S,(2008), Model Analisis Kinerja Klaster Industri Kecil (Klaster Supply Chain), Studi Kasus : Industri Kecil Tekstil dan Produk Tekstil di Bandung,Tesis, Industrial Engineering and Management ITB.

Freeman, Alan, (2008), Benchmarking and Undertanding London's Cultural and Creative Industries, MPRA Paper No.14776, posted 22 April 2009,http://mpra.ub.uni-muenchen.de/14776/

Gwynne, Robert, (2004), Clusters And Commodity Chains: Firm Responses to Neoliberalism in Latin America, Latin American Research Review 39. 3 (2004): 243-255.

Hongman Zhang, Jing Wang,Di Liu,(2011)Experiences of Creative Industries Development in Developed Countries and Enlightenments,Asian Social Science Vol. 126, No. 8; August 2011www.ccsenet.org/ass

Keane, Michael A and Hartley, John (2006) Creative industries and innovation in China. *International Journal of Cultural Studies*9(3):pp. 259-264.http://eprints.qut.edu.au

Muhammad Abi Sofian Abdul Halim, Shaladin Muda, Wan Abd Aziz Wan Mohd Amin, Ahmad Munir Mohd Salleh, (2012),The Significance Difference on Entrepreneurial Profile toward Entrepreneurial Personality in Micro and Small Business: Malaysia Creative Industry, Asian Social Science Asian Social Science Vol 8, No 3 (2012)

Muhammad Abi Sofian Abdul Halim, Shaladin Muda, Wan Abd Aziz Wan Mohd Amin, Ahmad Munir Mohd Salleh, (2012),The Measurement of Entrepreneurial Personality and BusinessPerformance in Terengganu Creative Industry, Asian Social Science Asian Social Science Vol 8, No 3 (2012)

Lenchuk, E B; Vlaskin, G A,(2010),A cluster-based strategy for Russia's innovative development,. Studies on Russian Economic Development 21. 6 (Nov 2010): 603-611.

Nugroho, Tricahyo (2011) ***Analisis Klaster Industri Untuk Meningkatkan Daya Saing Pada Industri Batik Di Surakarta (Studi Kasus di Kampung Batik Laweyan dan Kampung Batik Kauman).*** Undergraduate thesis, Diponegoro University.

M. Irfan Affandi,(2009), Konsentrasi Spasial, Kekuatan Aglomerasi Dan Klaster Sektor Agroindustri Di Provinsi Lampung, Seminar Hasil Penelitian Dan Pengabdian Masyarakat Unila.

Poter,M.E (1998), Cluster and New Economic of Competition. Harvard Business Review, Boston.

Sabine Hotho, Katherine Champion(2011), "We Are Always After That Balance" – Managing Innovation in the NewDigital Media Industries, Journal of Business and ManagementVol. 6, No. 6; June 2011

Widjajani Widjajani, Gatot Yudoko Jurnal Teknik Industri, Vol 10, No 1 (2008), Keunggulan Kompetitif Industri Kecil Di Klaster Industri Kecil Tradisional Dengan Pendekatan Berbasis Sumber Daya: Studi Kasus Pengusaha Industri Kecil Logam Kiara Condong, Bandung Jurnal Teknik Industri, Vol 10, No 1

THE DEVELOPMENT OF ISLAMIC FINANCING SCHEME FOR SMES IN A DEVELOPING COUNTRY: THE INDONESIAN CASE

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Abstract

Small Medium Enterprises (SMEs) have significant role in employment creation and growth of gross domestic products of developing country. In the case of Indonesia, SMEs account for more than 90 percents of all company and in employment. However, in order to grow and contribute more significantly to the economy, SMEs face some constraints. One of the main constraints faced by SMEs is the lack of finance. Islamic bank financing products may help to solve this problem. The Islamic participatory schemes, such as mudarabah and musyarakah, integrate assets of lender and borrowers; therefore, they allow Islamic banks to lend on a longer-term basis to projects with higher risk-return profiles and, thus, to support economic growth. However, as Islamic banks try to avoid uncertainties, the mentioned schemes are not widely used. Therefore, support from government and academia needed to create innovation in the participatory financing scheme so that all related parties can share mutual benefits. Using Indonesia data, the paper analyzes data from Indonesia‟s National Agency of Statistics and Central Bank of Indonesia and reviews key literature and secondary data on Indonesian SMEs and Islamic banks. In the end, the paper offers a framework in which Islamic financing scheme could be used to solve financing problem faced by Small and Medium Enterprises (SMEs) in the context of developing country.

Keywords: Indonesia, SME Financing, Developing Countries, Islamic Financing

SOCIAL RESPONSIBILITY AND PERFORMANCE MANAGEMENT IN SMALL AND MEDIUM ENTERPRISES: A CASE STUDY ON INCUBATED TECHNOLOGY-BASED SMEs IN BRAZIL

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Abstract
The objective of this paper is two-fold: (i) to propose a new evaluation model to assess incubated technology-based small and medium enterprises (SMEs) aligned to ISO 26000 guidelines; (ii) to validate the proposed model through a multiple case study on selected incubated technology-based SMEs. It was assumed that these enterprises have the potential to contribute to the promotion of sustainable development, through socially and environmentally sustainable operations, and by generating new sustainable products and services within the context of Triple Helix Model. The research methodology encompasses: (i) bibliographical and documental review on corporate social responsibility; technology-based SMEs management, Triple Helix model; and business performance evaluation, with especial attempt to the balanced scorecard model; (ii) design of a conceptual model that integrates the referred themes, within the perspective of future application in university incubators in Brazil; (iii) design, conduction, and scoring of semi-structured interviews with managers of selected incubated technology-based SMEs; (iv) development of a multiple case study focusing on these selected SMEs; and (v) formulation of suggestions for future research and application in other university incubators in Brazil. The main results can be summarized as follows: (i) an innovative evaluation model to assess incubated technology-based small and medium enterprises regarding the adoption of ISO 26000 guidelines; and (ii) a set of new indicators for selecting candidates and assessing performance of incubated enterprises aligned to ISO 26000 guidelines.

Keywords: Technology-based SMEs, Business incubators, Performance management, Social responsibility, Triple Helix model

1. Introduction

Business incubators nurture young firms, helping them to survive and grow during the start-up period when they are most vulnerable. Incubators provide hands-on management assistance, access to financing and orchestrated exposure to critical business or technical support services. They offer entrepreneurial firms shared office services, access to equipment, flexible leases and expandable space - all under one roof [1].

Focusing on technology business incubators, they provide mechanisms for technology transfer, promote the concept of growth through innovation and application of technology, support economic development strategies for small business development, and encourage growth from within local economies. From the historical and economic perspectives, the growing use of the technology business incubator strategy stems from evidences that industrial innovation has had demonstrable positive effects on regional economic growth. They have been considered a fundamental instrument for supporting entrepreneurship and as the birthplace of some of the most prominent techno poles.

Once economic sustainability is an inherent principle to the very conception of the technology business incubators, the challenge is how to improve incubated businesses performance by embedding social and environmental criteria and objectives into strategic and operational processes of incubators and incubated firms.

In Brazilian university incubators, it has been observed that the strategies and procedures for selecting candidates for incubation have been almost exclusively based on technical and economic requirements (including those of the market). There is a lack of data, studies, and systematic investigation about effective and potential contributions of business incubators for the incorporation of environmental and social dimensions into business strategies of incubated technology-based enterprises. Nevertheless, this reality could be changed still in this decade, with the reframing of the role of business incubators towards sustainable development, through socially and environmentally sustainable operations, and by generating new, sustainable products and services within the context of Triple Helix Model [2], [3], [4] and [5].

We assumed that the perception and reality of incubated technology-based enterprises' performance on social responsibility can influence: (i) the creation of new competitive advantages; (ii) reputation; (iii) organizational capacity to attract and retain workers and fulfill their stakeholders' expectations; (iv) maintenance of employees' morale, commitment and productivity; and (v) relationship with companies, governments, the media, their stakeholders and communities in which they operate.

From this perspective, the objective of this paper is two-fold: (i) to introduce a new conceptual generic model to assess incubated technology-based small and medium enterprises (SMEs) concerning the adoption of ISO 26000 guidelines; and (ii) to demonstrate its applicability through a multiple-case study on selected incubated technology-based SMEs.

2. Theoretical background

Figure 1 shows a general vision of the main and specific themes considered in the theoretical background.

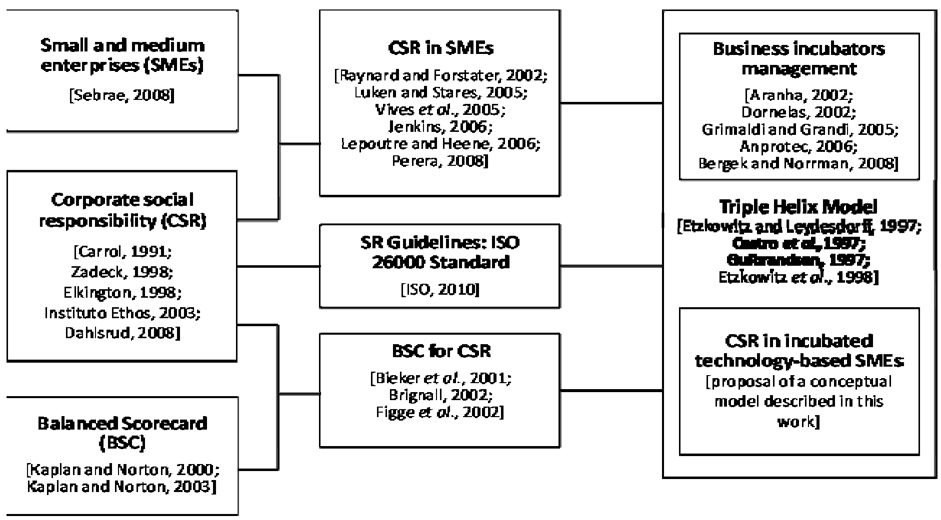

Fig.1. Theoretical background: an overview

In the next subsections, we present and discuss the basic concepts and the main works concerning core and specific themes of the research, as depicted in Figure 1.

2.1 Corporate social responsibility (CSR)

Dahlsrud [6] analyzed 37 definitions of CSR and came to the conclusion that although all of them are consistent, they don't make it clear how social responsibility is constructed in a determined economic, cultural and social context.

The most general and accepted concept of SR refers to four categories defined by Carroll [7]. The Carroll's model includes economic, legal, ethical and voluntary responsibilities. These categories are not mutually exclusive, having on one side economic interests and on the other social interests. The relevance of Carroll's model stems from the basic assumption that social responsibility should not be assessed separately from the economic performance, thus being part of the global responsibility of the enterprise.

In this work, we assumed the Instituto Ethos de Empresas e Responsabilidade Social's definition, as follows:

“[...] the way of management that defines itself by the ethical and transparent relation of the enterprise as a whole with all of the audiences in which it has a relationship and by the establishment of corporate goals compatible with the sustainable development of society, preserving environmental and cultural resources for future generations, respecting diversity and promoting the reduction of social inequities [8, p.12].

For the purposes of this work, we emphasize that enterprises should integrate social and environmental criteria at the normative level of strategic management of their businesses, translating these criteria into objectives and goals, whose results and performance can be measured in a systemic view.

2.2 Small and medium enterprises (SMEs) and CSR in SMEs

For the definition of small and medium enterprises, we used the classification adopted by Serviço Brasileiro de Apoio às Micro e Pequenas Empresas [9, p. 11]:

- Micro enterprise: in the industry, up to 19 people workers; on trade and services, up to 09 workers;
- Small enterprise: in the industry, from 20 to 99 workers; on trade and services, from 10 to 49 workers;
- Medium enterprise: in the industry, from 100 to 499 workers; on trade and services, from 50 to 99 workers.
- Large enterprise: in the industry, over 500 workers; on trade and services, over 100 workers.

To implement SR in large firms is not necessarily the same as in SMEs. Large enterprises can better illustrate SR results which are beneficial to their own images. This impact is unquestionably far greater than those of SMEs. The development of theoretical models focusing on SR in SMEs doesn’t evolve at the same growth rate of scientific production regarding large enterprises. This can be explained in part due to barriers of integrating all the types of SME into one analytical framework. The global set of SMEs is very diverse and their behavior has been influenced by a number of different factors, which stimulate, in turn, the emergence of different conceptual frameworks concerning the research on SR in SMEs.

From the literature review, we could find studies arguing that SMEs are better positioned and equipped to support socially responsible behavior than large enterprises. On the other hand, several researchers have argued that, in practice, SMEs present themselves as an obstacle to the implementation of a SR philosophy, comparatively to large enterprises. SMEs’ managers point out that they don’t have enough time or resources to devote to SR, even the attendance of legal requirements constitutes, at times, a difficulty.

The previous empirical works carried out by Raynard and Forstarter [10]; Vives *et al*. [11]; Lepoutre and Heene [12]; and Perera [13] reinforced those difficulties and proposed recommendations to future studies, which were considered and discussed during the second phase of this work (multiple-case study).

2.3 Business performance evaluation and the Balanced Scorecard tool

Balanced Scorecard or BSC is a tool of strategic planning and global performance assessment that became commonly recognized as a system of strategic management, communication and performance evaluation by various organizations all over the world: enterprises, governmental agencies, and institutions of Science, Technology and Innovation (S,T&I).

As defined by Kaplan and Norton [14], the BSC model translates an organization’s mission and strategy into a comprehensive set of performance measures that provides the framework for a strategic measurement and management system”. This strategic management system measures global performance in four ‘balanced’ perspectives: (i) ‘financial’, that summarizes “the readily measurable economic consequences of actions already taken”; (ii) ‘market’, that contains measures that identify the customer and market segments in which the organization will compete and the measures of the organization’s performance in these targeted segments; (iii) ‘internal process’ that measures the critical internal processes in which the organization must excel; and (iv) ‘learning and growth’ that measures the infrastructure that the organization must build to create long-term growth and improvement.

With an attempt to apply the BSC model in incubated technology-based SMEs within the perspective of CSR, we will discuss in the next section the potential of the BSC model as an assessment tool for 'measuring' in this particular context the adoption of SR guidelines posed by ISO 26000 Standard.

2.4 Applicability of BSC considering SR aspects

Despite the success experienced by Kaplan and Norton regarding the acceptance of BSC model, since 1996, when their book titled "The Balanced Scorecard: translating strategy into action" was launched, authors like defined by Bieker et al. [15], Figge et al. [16], and Brignall [17] have argued that the use of financial and human resources did not figure anymore as the only determinant factors for promoting competitive advantages. More recently, global management consulting firms have written about the pressures facing firms with regard to social and environmental issues. In that sense, it is worth mentioning the evidence matrix proposed by SustainAbility and applied, in Brazil, by Instituto Ethos. This matrix seeks to explain the relationships between the initiatives or results concerning the three dimensions of 'Triple Bottom Line' approach [18]. Even more, it puts into evidence the potential economic benefits that can be explored by environmental and socially responsible practices [19], and [20].

From this perspective, Bieker [21], Brignall [22], and Figge *et al.* [23] launched a different perspective concerning BSC tool, with an attempt to determine how enterprises can benefit from a 'Sustainable Strategic Map', incorporating adaptations to the original concept formulated by Kaplan and Norton. The lack of integration between the three dimensions (economic, social and environmental) on the usual BSC tool still represents an obstacle for organizations incorporating SR objectives and initiatives into their strategies in an effective way. The creation of a 'Sustainable Strategic Map', based upon BSC model, allows organizations to evaluate and implement environmental and social initiatives within a strategic view, at all levels of the corporation. The 'Sustainable Strategic Map' also contributes to communicate and transform CSR into a constant, planned and well-measured business issue.

To integrate the social and environmental aspects to conventional BSC, Figge *et al.* [24] suggested three alternatives for the construction of a 'Sustainable Strategic Map'. They are: (i) incorporation of the social and environmental dimensions in three of the original perspectives of the BSC; (ii) creation of a fifth perspective exclusive to the environmental and social dimensions; and (iii) creation of an exclusive BSC for the environmental and social sustainability, but dependent of one of the previous alternatives.

In the first alternative, the emphasis relies on the integration of relevant environmental and social issues into three of the four perspectives of the conventional BSC, which are then translated into objectives, goals and strategic indicators linked to the fulfillment of the corporate mission and, also, to short, medium and long term business plans. Since this new issues become an integral part of the BSC as a whole, they facilitate comprehension by managers and by work-force about the cause-and-effect relationships among environmental, social and economic issues. The strategic objectives and goals should be oriented hierarchically for the financial perspective, converging into a successful business strategy with triple the results (economic, social and environmental sustainability), as recommended by Elkington in his matrix of evidences [25].

The second option proposed by Figge *et al.* comprises the creation of a fifth perspective, only for the environmental and social dimensions, beyond the four on the conventional BSC. In this second alternative, the authors stress that the necessity of creating a new perspective (social and environmental) comes from the idea that environmental and social aspects cannot be reflected simultaneously in the four perspectives. However, by integrating environmental and social aspects to the strategy of the organization, the cause-and-effect relationships can be directly observed between social and environmental initiatives and financial perspective, and indirectly in the other perspectives.

Finally, the third alternative proposes a generation of a BSC exclusively created for environmental and social issues, apart from the main BSC, but totally dependent on one of the previous alternatives.

Considering the context of technology-based SMEs generated in a university incubator and also the objectives of the present work, the first alternative was adopted as a basis for designing a conceptual generic model to assess incubated technology-based small and medium enterprises (SMEs), considering ‘Social Responsibility’ perspective. It was assumed, in practical terms, that this alternative was the most simple and easy-to-apply and could effectively help incubated technology-based small and medium enterprises (SMEs) to adopt SR guidelines and to embed SR good practices in their operations, products and services.

3. The International Standard in Social Responsibility (ISO 26000) and incubated technology-based SMEs

ISO 26000 provides guidance for all types of organization, regardless of their size or location, on: (i) concepts, terms and definitions related to social responsibility; (ii) background, trends and characteristics of social responsibility; (iii) principles and practices relating to social responsibility; (iv) core subjects and issues of social responsibility; (v) integrating, implementing and promoting socially responsible behavior throughout the organization and, through its policies and practices, within its sphere of influence; (vi) identifying and engaging with stakeholders; (vii) communicating commitments, performance and other information related to social responsibility.

According to ISO [26], the SR Standard ISO 26000 is intended to: (i) assist organizations in contributing to sustainable development; (ii) encourage them to go beyond legal compliance, recognizing that compliance with legislation is a fundamental duty of any organization and an essential part of their social responsibility; (iii) promote common understanding in the field of social responsibility, and to complement other instruments and initiatives for social responsibility, not to replace them.

Concerning its implementation, the ISO 26000 document includes a text directly addressed to SMEs (ISO, 2010 - Section 3.3.4 – Box 3). Although it doesn’t intend to establish any specific orientations to SMEs, this text highlights and articulates aspects of the ISO 26000 standard that can facilitate its interpretation and application by these enterprises and also by technology business incubators.

We assumed in this research that technology business incubators, within the Triple Helix Model, can serve as facilitators for the insertion of effective SR practices on the reality of SMEs nurtured by them, reversing the undesirable signals above mentioned. Since technology business incubators adopt management tools for integrating SR practices in SMEs nurtured by them, they will be effectively fulfilling their role, as catalyzing agents for developing entrepreneurs within SR perspective. We also believe that the conceptual model presented in section 5, illustrated by a multiple-case study in Brazil, can contribute to a critical reflection on the ongoing methods used by incubators and incubated firms and, more important, on the real possibilities of applying SR principles and practices within the organizational contexts of university incubators and their incubated technology-based enterprises. This is the future vision preconized by those who participated in the ISO 26000 standardization process, as follows: “maximization of the contribution of the organization for sustainable development” [27].

4. Methodology

The methodology adopted during the research project encompasses three main phases, as follows: (i) exploratory phase, comprising bibliographical and documentary concerning the research central themes, as mentioned before; (ii) applied research, focusing on the development of a multiple-case study, involving six technology-based SMEs, incubated in Instituto Genesis (PUC-Rio, Brazil); and (iii) the conclusive-reflexive phase.

Complementarily to bibliographical and documentary review, a particular documentary research was carried out concerning business contexts and profiles of the SMEs selected for the multiple-case study. In this phase, a conceptual model was designed as a basis for the applied research phase. It was an innovative model for assessing how technology-based SMEs incubated in a university incubator have implemented SR practices and initiatives according to ISO 26000 framework.

In the subsequent phase, this model was validated empirically by selected enterprises incubated at Instituto Genesis da PUC-Rio, adopting a multiple-case study protocol, as presented by Yin (2005). Based on Yin's typology, we selected a holistic multiple-case study, considering groups of enterprises that are suppliers of products and services for the followings sectors: (i) energy, oil and gas; (ii) telecommunications; and (iii) environmental area.

The development of the multiple-case study comprised six steps, as follows: (i) selection of the type of case study and delimitation of units of analysis; (ii) elaboration and pre-test of the instrument of field research (descriptive material related to the conceptual model in a didactic format for an easy application by the selected SMEs, through semistructured interviews); (iii) data collection by interviews with the directors of six selected SMEs, data treatment and analysis; (iv) presentation and discussion of results; (v) empirical validation of the conceptual model by the directors of SMEs and the incubator managers; and (vi) conclusions of the multiple-case study, including a set of recommendations and suggestions for future works.

5. Conceptual model for assessing SR in incubated technology-based SMEs

The conceptual model aims to assess how incubated technology-based small and medium enterprises (SMEs) can be aware of SR importance for creating value for their business and adopt guidelines posed by ISO 26000 Standard. We decided to adopt the ISO 26000 standard as a reference framework for the inclusion of SR business issues into strategic planning and performance assessment of these SMEs for two reasons: (i) the ISO 26000 standard is guidance for all types of organization, regardless of their size or location; and (ii) it may offer supply chain opportunities to SMEs.

According to the general schema represented in Fig. 2, it encompasses a sequence of four modules: (i) Module 1 – 'Definition of business model and value propositions'; (ii) Module 2 – 'Selection of SR issues from ISO 26000 framework'; (iii) Module 3 – 'Prioritization of SR initiatives and practices'; and (iv) Module 4 – 'Building the Sustainable Strategic Map for incubated technology-based SMEs'. The conceptual model and the multiple-case study findings presented in this article are a synthesis of an MSc dissertation concluded in 2011 [28].

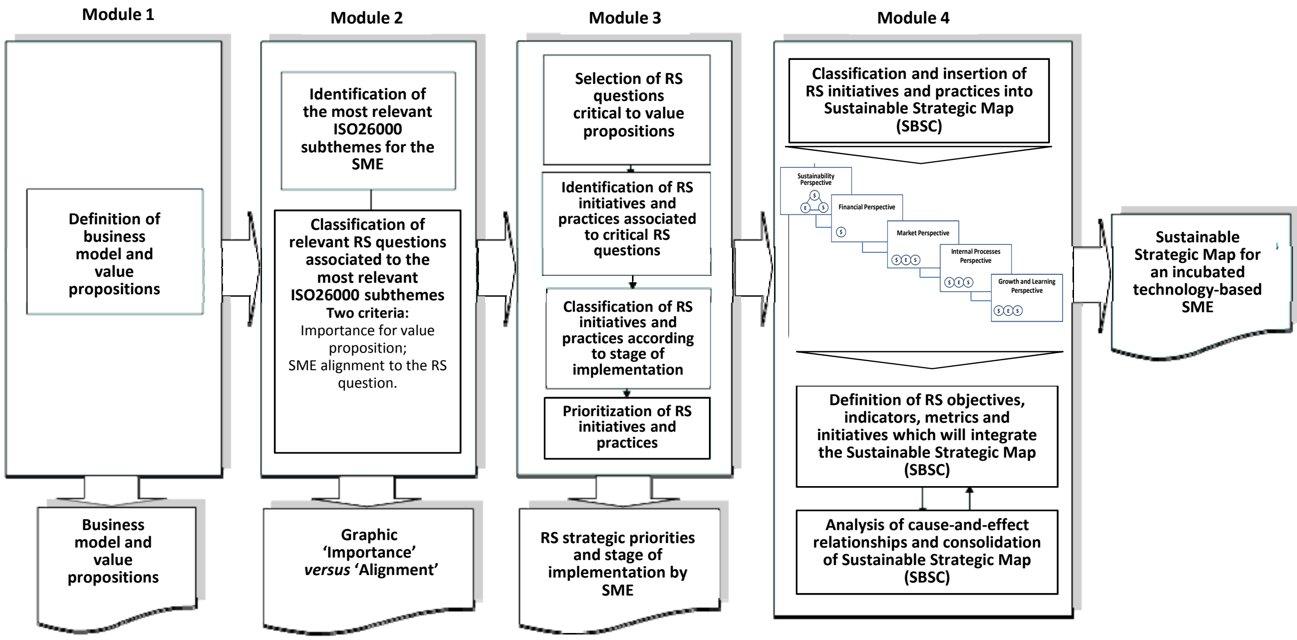

Fig. 2. General representation of conceptual model for assessing SR in incubated technology-based SMEs

6. Multiple-case study findings and interpretation

The conceptual model was empirically validated by six selected SMEs incubated at Instituto Genesis (PUC-Rio, Brazil). By means of a multiple-case study protocol, as presented by Yin (2005), managers from the selected enterprises were interviewed for this case study. The SMEs integrate supply chains of relevant sectors in Brazil, as follows: (i) energy, oil and gas; (ii) telecommunications; and (iii) environmental area.

This multiple-case study allowed the identification of SR issues that most affect directly and strategically the performance of SMEs in SR, as showed in Table 1.

Table 1: Most important SR Issues and Questions for SMEs interviewed

Most important SR Issues for SMEs interviewed	Number of questions associated to SR issue
Health and safety at work	13
Organizational governance	6
Consumer service, support, and complaint and dispute resolution	5
Technology development and access to technologies	4

Promoting social responsibility in the value chain	3
Climate change mitigation and adaptation	3
Human development and training in the workplace	3
Education and awareness	2
Wealth and income creation	2
Consumer data protection and privacy	2
Prevention of pollution	1
Anti-corruption practices	1
Total: 12 SR issues	Total: 45 SR questions

Among the SR 345 questions associated to the 36 SR issues that integrate ISO 26000 framework, 45 were considered the most important and strategic for the six incubated technology-based SMEs. From them, 8 questions were indicated as priority by at least 3 SMEs interviewed.

The core issues of ISO 26000 considered the most important by interviewed SMEs were also identified. They were: (i) 'Labor practices, with 16 SR questions considered as priorities; (ii) 'Community involvement and development, with 8 SR questions; (iii) 'Consumer issues, with 7 SR questions; (iv) 'Organizational governance', with 6 SR questions; (v) 'The environment', with 4 SR questions; (vi) 'Fair operating practices, with 4 SR questions.

6. Conclusions, policy implications and directions for future works

This work aimed to present a new conceptual model to assess social responsibility of incubated technology-based small and medium enterprises (SMEs) aligned to ISO 26000 guidelines. Its applicability was demonstrated by means of a multiple-case study on selected graduated technology-based SMEs which were nurtured in Instituto Genesis (PUC-Rio, Brazil).

It is believed that this model, due to its flexible, dynamic and systemic characteristics, can be useful not only for incubated SMEs, but also for managers of technology-based incubators, and for associations, regional and national networks, within the wide context of business incubators.

Managers of SMEs, public managers in general and academic specialists can also take advantage of the knowledge here generated to improve their SR strategies, by adopting in next future ISO 26000 guidelines.

Based on the results here presented, we recommend:

- To apply the conceptual model and support material (templates, graphs etc.) on incubated enterprises in Institute Genesis (PUC-Rio, Brazil), within the perspective of review its current selection process of candidates and performance assessment of the incubated enterprises;
- To define a national strategy together institutions with potential interest in its application at national level;

- To develop an IT application that allows the diffusion and implementation of this assessment tool to other incubated enterprises (in Brazil and other countries);
- To create a database with the results generated by incubated enterprises from Instituto Genesis, after applying the assessment tool, and utilize non-parametrical statistical analysis for the treatment and analysis of the collected data.

As a final conclusion, it is possible to expect that implementation of this model in a broader context would lead to SR desired interactions, as conceived in 'Triple Helix Model' for innovation studies and initiatives.

We believe that implementation of SR guidelines by incubated technology-based SMEs; the adoption of new approaches - aligned to ISO 26000 guidelines - by business- technology incubators; and also the creation of sustainable businesses by SMEs fostered by public policies, will strongly contribute to the blurring of institutional boundaries, as preconized in 'Triple Helix III'.

References

[1] National Business Incubation Association. Business incubators. NBIA (2012). Business incubators. 2012. Available at: <http://www.nbia.org/>. Access: June 10th, 2012.

[2] Gulbrandsen, M. (1997) Universities and Industrial Competitive Advantage. p. 121-31. In: Etzkowitz, H.; Leydesdorff, L. (eds.). Universities in the Global Economy: A Triple Helix of University-Industry-Government Relations. London: Cassell Academic, 1997.

[3] Etzkowitz, H.; Leydesdorff, L. (eds.). (1997) Universities in the Global Economy: A Triple Helix of University-Industry-Government Relations. London: Cassell Academic, 1997.

[4] Etzkowitz, H.; Webster, A.; Healey, P. (1998) Capitalizing Knowledge: the Intersection of Industry and Academia. Albany: State University of New York Press.

[5] De Castro, E.A.; Rodrigues, C.J.; Nogueira, F.; Pires, A.R. (1998). Regional Innovation Systems - The Analysis of the Portuguese Case Based on the Triple Helix Concept. Paper presented at the Triple Helix II Conference, New York/Purchase, January 1998.

[6] Dahlsrud, A. (2008). How corporate social responsibility is defined: an analysis of 37 definitions. Corporate Social Responsibility and Environmental Management, v.15, n.1, p. 1-5.

[7] Carroll, A. (1991). The pyramid of corporate social responsibility: toward the moral management of organizational stakeholders. Business Horizons, v.34, n.4, p.39-48.

[8] Instituto Ethos de Empresas e Responsabilidade Social. Práticas empresariais de responsabilidade social (2003). [Carmen Weingrill, coordenadora]. São Paulo: Instituto Ethos, 2003. Available at: <http://www.ethos.org.br/sistemas/ifc/>. Access: June 10th, 2012.

[9] Serviço Brasileiro de Apoio a Micro e Pequenas Empresas. Sebrae (2008). Anuário do trabalho na micro e pequena empresa. Brasília: Sebrae.

[10] Raynard, P.; Forstarter, M. (2002). Corporate social responsibility: implications for small and medium enterprises in developing countries. Vienna: Unido.

[11] Vives, A.; Corral, A. Isusi, I. Responsibilidad social de la empresa en las PyMEs de Latinoamérica. Inter-American Development Bank. 2005. Available at: <http://www. ibddocs.iadb.org/wsdocs>. Access: June 10th, 2012.

[12] Lepoutre, J.; Heene, A. Investigating the impact of firm size on small business social responsibility: a critical review a critical review, Journal of Business Ethics, v.67, n.57, p.273 – 273.

[13] Perera, O. (2008). How material is ISO 26000 social responsibility to small and medium-sized enterprises (SMEs)?. International Institute for Sustainable Development (IISD). Available at: <http://www.iisd.org/pdf/2008/how_material_iso_26000.pdf>. Access: June 10th, 2012.

[14] Kaplan and Norton (2004). Strategy maps: converting intangible assets into tangible outcomes. Harvard Business Review Press, 1st edition.

[15] Bieker, T. *et al.* (2001). Towards a sustainability balanced scorecard linking environmental and social sustainability to business strategy. In: Proceedings of the 2001 Business Strategy and the Environment Conference. Leeds, U.K. 10-11 September, 2001.

[16] Figge *et al.* (2002). The sustainability balanced scorecard –linking sustainability management to business strategy. Business Strategy and the Environment, v.11, p.269–284.

[17] Brignall, T.J.S. (2002). The unbalanced scorecard: a social and environmental critique. In: Neely A., Walters A. and Austin R. (eds). Performance measurement and management: research and action. Boston: Performance Measurement Association.

[18] Elkington, J. (1998). Cannibals with forks: the triple bottom line of 21st century business. Oxford: U.K. Capstone Publishing Limited, 1998.

[19] Sustainability (2001). Buried Treasure: uncovering the business case for corporate sustainability. February 2001. Available at: <http:// www.sustainability.co.uk>. Access: June 10th, 2012.

[20] Instituto Ethos de Empresas e Responsabilidade Social. Práticas empresariais de responsabilidade social (2003). [Carmen Weingrill, coordenadora]. São Paulo: Instituto Ethos, 2003. Available at: <http://www.ethos.org.br/sistemas/ifc/>. Access: June 10th, 2012.

[21] Bieker, T. *et al.* (2000). Towards a sustainability balanced scorecard linking environmental and social sustainability to business strategy. In: Proceedings of the 2001 Business Strategy and the Environment Conference. Leeds, U.K. 10-11 September, 2001.

[22] Brignall, T.J.S. (2002). The unbalanced scorecard: a social and environmental critique. In: Neely A., Walters A. and Austin R. (eds). Performance measurement and management: research and action. Boston: Performance Measurement Association.

[23] Figge *et al.* (2002). The sustainability balanced scorecard –linking sustainability management to business strategy. Business Strategy and the Environment, v.11, p.269–284.

[24] Figge *et al.* (2002). The sustainability balanced scorecard –linking sustainability management to business strategy. Business Strategy and the Environment, v.11, p.269–284.

[25] Sustainability (2001). Buried Treasure: uncovering the business case for corporate sustainability. February 2001. Available at: <http:// www.sustainability.co.uk>. Access: June 10th, 2012.

[26] International Organization for Standardization. ISO (2010). ISO 26000:2010 Guidance on social responsibility. Geneve: ISO.

[27] International Organization for Standardization. ISO (2010). ISO 26000:2010 Guidance on social responsibility. Geneve: ISO.

[28] Jourdan, C. A. Normalização e responsabilidade social empresarial em pequenas e médias empresas: estudo de caso de PMEs de base tecnológica em uma incubadora. MSc. Dissertation. Pontifical Catholic University of Rio de Janeiro. Post-graduation Program in Metrology, Quality and Innovation, 2011.

CAPITAL AS MODERATOR VARIABLE BETWEEN ENTREPRENEURSHIP AND SMALL ENTERPRISE PERFORMANCE

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Abstract
This paper discuss about small enterprise in food and beverage industry, especially in terms of the capital as a moderator variable. So far, we are more interested to the capital and entrepreneurships influence on the performance of business. Which of the two things that are actually more important in improving the performance of small enterprise, were much-debated; Is it better to provide capital first and then increase entrepreneurship, or vice-versa. Government and private sector already provided lots of venture funding schemes, as well as training, and entrepreneurship training for small enterprise; but the accessibility and participation of the intended target is still low. Discussions of the indirect effects of capital on performance, namely through entrepreneurship variable has not been much studied. This is the reason why the role of capital as a moderator variable appealing and need to be investigated. The study is a quantitative study, using survey methods. Target population is food and beverage industry in Bandung, Indonesia, with a sample size of 200 small businesses. Cluster random sampling technique was used. Capital is defined as operating assets measured in rupiahs. Entrepreneurship measured in the score on its 37 indicators, grouped into three skill dimensions, namely technical skills, business management skills, and personal entrepreneurial skills. Business performance is measured by two indicators, namely sales and profit, in units of rupiahs. The data used is the primary and secondary data, collected with interview techniques, with a questionnaire instrument that has tested the validity and reliability. Data were analyzed using Structural Equation Models (SEM).

1. Introduction

1.1. Background

Alisjahbana [1] stated that The National Development Planning Agency has identified three key sectors that could be prioritized to be the motor of future economic growth called labor intensive manufacturing sector. One is food and beverage industry, the major are small and medium enterprises.

According to Widi [2] the Government has actually made and implemented policies regarding financing cooperatives, small, and medium enterprises. Policies relating to banking, among others: Pakjun 1983, Pakto 1988, Pakjan 1990, Pakfeb 1991, KUK 1983 to 1992 (KIK / KMKP, Rural Credit Cooperatives Service Center Programme, Candak Kulak Completion Credit Pilot Project, Development Bank-SHG relationship Programme, District Loan programmes (BKK, LKPD,KURK), the Banking Law UU No.7/1992, KUK 1992 to 1996, the Banking Law. Indonesian Small Business Research Centre [3] stated that also sourced from the national budget, the funds allocated to the small business sector also comes from the allowance / SOE profits in the form of allocation of funds and cooperative development of small businesses (PUKK). It also comes from donor agencies such as: ADB, BORDA, Swisscontact, The Asia Foundation, USAID, Friedrich Ebert Stiftung, CIDA, Fado, AdenaeurStiftungKonrad, Mercy Corp International, Oxfam Great Britain, and the European Union. Another policy is the enactment of UU No. 20 of 2008 on Micro, Small and Medium Enterprises [4], stated that empowerment objectives to be achieved are: to realize a balanced and just, national economic structure, foster and develop the capabilities of Micro, Small and Medium Enterprises into a strong and independent businesses, and enhance the role of Micro, Small and Medium Enterprises in local development , job creation, income generation, economic growth, and alleviation of the people from poverty.

With the existence of government supports as above, the goals of small business empowerment is expected to be achieved. For becoming strong and independent businesses, small businesses must not just be able to survive but also to grow and develop.

Zimmerer and Scarborough [5] stated that there were ten deadly mistakes of entrepreneurship: a) management mistakes, b) lack of experience, c) poor financial control, d) weak marketing effort, e) failure to develop a strategic plan, f) uncontrolled growth, g) poor location, h) improper inventory control, i) incorrect pricing, and j) inability to make the “entrepreneurial transition”. Then they concluded that because of their limited sources, inexperienced management, and lack of financial stability, small business suffer a mortality rate significantly higher than that of larger, more established business. According to Gregory, et al. [6] studies on small and medium-sized enterprises di

USA, empirically tests the financial growth cycle model for small and medium-sized enterprises (SMEs), which postulates that as firms become larger, older, and more information transparent, their financing options become more attractive. The results of its research showed that partially support the financial growth cycle model. Specifically show larger firms, as measured by total number of employees, are more likely to use public equity funding or long-term debt as opposed to insider funding. Aspiranti [7] views from the nonbank institutions that provide loans, and concluded that information cost, capital, risk and competitive factors influence nonbank institution performance in lending for small and medium enterprise.

This paper discuss about small enterprise in food and beverage industry, especially in terms of the capital as a moderator variable. So far, we are more interested in a direct influence on the performance of capital and entrepreneurial business. Government and private sector has a lot of effort to provide funding scheme, as well as training, entrepreneurship training for small enterprise, but the accessibility and participation of the target is still low. A discussion of the indirect effect of capital on performance, namely through entrepreneurship variable has not been much studied. This is the reason why the role of capital as a moderator variable attractive and need to be investigated

1.2. Problem formulation

The research question in this case can be formulated as follows:

1. Is capital a variable moderator that could improve entrepreneurship influence on small business performance
2. How powerful the direct and indirect influence of capital on small business performance
3. How is the influence of entrepreneurship to small business performance

2. Literature Review and Theoretical Framework

Even though Siropolis [8] and Hisrich and Peters [9] stated entrepreneurs has two objectives in its business, that is financial and nonfinancial goals; on the other hand, according to Meredith [10], financial goals could be focused upon. Ghosh, Kim and Meng [11] research results on small businesses in Singapore, revealed that the majority of small businesses measure the success based on the criteria of its net income growth, and growth in revenue. Net profit growth comes from growth in revenues, mainly from product sales and cost efficiency. Product sales growth comes from the growing number of products sold and the price. Cost efficiencies derived from the scale. Horngren, et al. [12] stated operating income is the difference between total revenues from operations to income taxes excluding cost.

According to Hatten [13] the process of entrepreneurship and small business management get through a 6 stages spectrum: innovation, triggering event, implementation, growth, maturity, harvest. The first three stages are called the entrepreneurship process and the subsequent three stages are referred to as small business management process. The first three processes are the process of innovation or the birth of the idea of starting a business, then followed by idea realization, followed by the establishment of business organizations. When defined in terms of organization, rather than the personal, the entrepreneurship process has been completed at that stage, and then the business management process began, that is the process of managing a small business from development phase (growth), stage of maturation (maturity), and stage of reaping (harvest). Not every business is able to reach the stage of maturity, so they couldn't reap what they've sow.

Siropolis [8] convey the sense of entrepreneurship in the context of comparisons with management as a thing, whereas Hatten [13], Hisrich and Peters [9] also seen from the side of entrepreneurship as a process. Here could be defined that entrepreneurship is the process of identifying opportunities for the which marketable needs exist, creating something different with value by devoting the necessary time and effort, and assuring company with financial, psychic, the risk of creating an organization, social risk, and receiving the resulting rewards of monetary and personal satisfaction and independence. An entrepreneur is a person who needs the vision to spot opportunity and takes advantage of it, and the ability to take financial, material, and psychological risk of starting or running company

According to Miller and Meiners (14), the theory of entrepreneurial behavior or entrepreneurial economics, shift the focus of the microeconomics of markets, as impersonal feedback giver, to creative economic agent character in maximizing profits and utility. The entrepreneurship option giver theory is very different from the traditional neoclassical microeconomic theory that highlights the economic agent as just a mechanical reaction giver. Consumers, who are always emphasized in entrepreneurship theory, is always involved in the market. Consumers are not just looking for cheaper goods, but also trying to get a new, previously unknown way of using known items, as well as new, previously unknown items for a known purpose. Manufacturers no longer just seen as users of technology and resources to meet consumer demand for its products, but as a persistent searcher for cheaper new input replacements, formulating better organizational and production, actively seek and try to decrease consumer promotion costs. Market is the fee provider or profit to the producer and consumer satisfaction. Creative Producers and consumers increase the input and output utility, whether old or new.

Based on behavioral theories of entrepreneurship or entrepreneurial economics, it can be underlined that entrepreneurship can directly influence the achievement of operating income and utility. Capital is no longer a dominant factor, since with creativity of the input factors can be obtained a cheaper and more efficient process. Thus in a business, entrepreneurial capabilities directly influence business performance, while the capital is one of the supporters.

According to Ghozali [15] in the context of linear model structure social studies, sometimes cannot describes actual reality. In certain cases where the theory suggests that the influence of a single exogenous latent variable on an endogenous latent variable is moderated by the second exogenous variable, giving rise to non-linear variable relationship. According to Ghozali [15] moderation variable is a variable that can strengthen or weaken the relationship between independent and dependent variables. According to Sauer and Dick [16] the definition of a moderator variable is a qualitative or quantitative variable that affects the direction and / or strength of the relation between an independent and dependent or criterion variable. If Z=f(X) and W is a moderator variable, then for different values of W, the form and/or strength and/or sign of the Z=f(X) relationship may vary depending upon the value of W.

3. Methodology

The study is a quantitative study, using survey methods. Target population is food and beverage industry in Bandung, Indonesia, with a sample size of 200 small businesses which were spread over five areas of Bandung City. This used cluster random sampling technique. The Bandung area divided into five clusters: Western, Eastern, Central Bandung, Northern, and Southern Bandung.

Capital is defined as operating assets measured in rupiahs. Entrepreneurship measured in the score on 37 indicators, grouped into three skill dimensions, namely technical skills (13 indicators), business management skills (13 indicators), and personal entrepreneurial skills (11 indicators). The score were based on Likert scaling, with the highest criteria worth 5 points, and the lowest 1 point. Business performance is measured by two indicators, namely sales and profit, in units of rupiahs.

The data used is the primary and secondary data, collected with interview techniques, with a questionnaire instrument that has tested the validity and reliability. To test the validity and reliability of the data measuring instrument, The SPSS program packet is used. On SPSS program, validity and reliability testing were included in one menu. Based on analysis results, 0,7 points of alpha cronback value were obtained for all research indicator instruments. Data measuring instruments reliability were based on Anova analysis results that shows the count opportunity = 0,0000 which means the test results were significant. Thus the instruments used in this study is valid and reliable

The way of formulating structural equation model and notation making according to Bacharudin and Tobing [17]

The structural equation model as follows:

$$\eta_1 = \gamma_{11}\,\xi + \varsigma_1 \quad (1)$$

$$\eta_2 = \gamma_{21}\,\xi + \beta_{21}\,\eta_1 + \varsigma_2 \quad (2)$$

with y measurement model as follows:

$$Y_{i1} = \lambda_{i1}^{(Y)}\,\eta_1 + \varepsilon i \text{, and } Y_{i2} = \lambda_{i2}^{(Y)}\,\eta_i \quad (3)$$

The statistical hypotheses:

Hypothesis 1:

H0: ≤ 0 (4)

H1: >0 (5)

Hypothesis 2:

H0: ≤ 0 (6)

H1: > 0 (7)

Hypothesis 3:

H0: ≤ 0 (8)

H1: > 0 (9)

In this study uses the following conditions: If the testing of the first and second hypothesis above yields null hypothesis rejecting-outcome then could be concluded that the capital is a moderator variable between entrepreneurship with small business performance. Its means capital business performance is able to strengthen the entrepreneurial influence on business performance. This is demonstrated by the indirect effect of capital to business performance that through entrepreneurship, which is positive and significant. The third hypothesis was tested to find out to what extent the direct positive influence of capital to business performance. Tests were carried out with $\alpha = 0.05$.Data were analysed using Structural Equation Models (SEM) with LISREL package program.

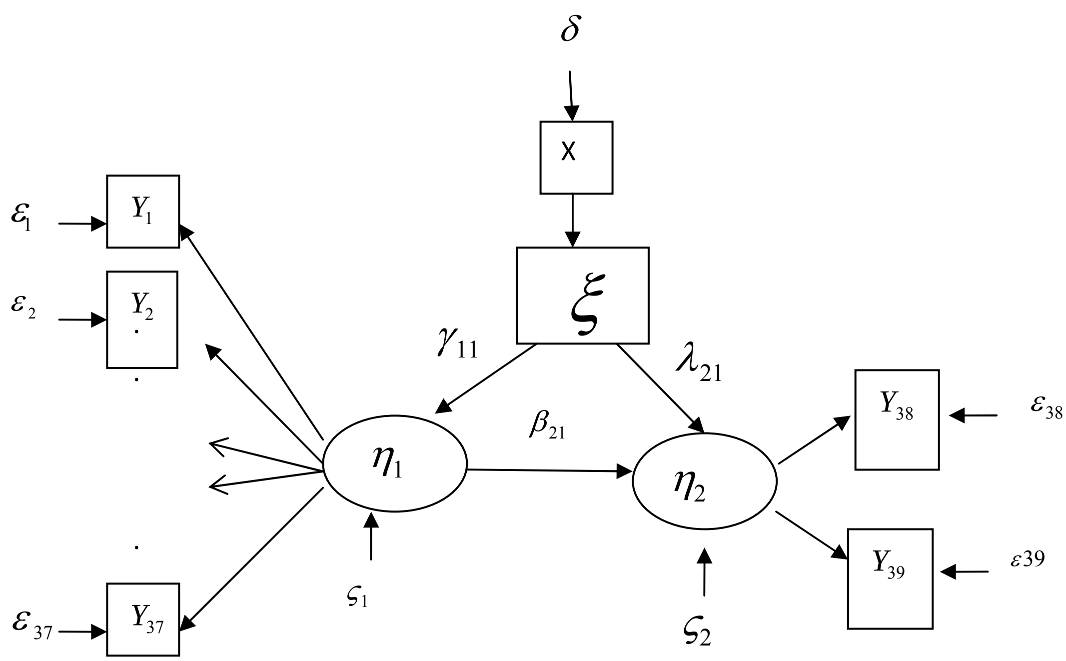

Fig. 1. *R*esearch variables relationship

4. Findings and Interpretation

4.1. Confirmatory factor analyses on entrepreneurship and business performance construct

Capital is an observable variable; however entrepreneurship and performance are unobservable variable (construct). Therefore, both variables needed confirmatory factor analyses.

Table 1. Estimation results and indicators of entrepreneurship influence significance (confirmatory factor analyses)

Dimension/ Indicator	S.E. Coeff.	t-value	R	Measurement error	Significance
Technical Skills:					
Writing	0.79	9.17	0.620	0.3759	Significant
Oral communication	0.67	9.58	0.450	05511	Significant
Monitoring environmental	0.57	9.74	0.330	0.6751	Significant
Technical business management	0.13	9.97	0.017	0.9831	Significant
Production Technology	0.24	9.94	0.060	0.9424	Significant
Interpersonal	0.23	9.95	0.052	0.9471	Significant
Listening	0.06	9.97	0.004	0.9964	Significant
Ability to organize	-0.11	9.97	0.012	0.9879	Significant
Network building	0.63	9.65	0.400	0.6031	Significant
Management style	-0.15	9.96	0.021	0.9775	Significant
Coaching	0.15	9.96	0.023	0.9775	Significant
Being a team player	0.22	9.95	0.048	0.9516	Significant
Business Management Skills:					
Planning and Goal Setting	0.76	9.32	0.570	0.4224	Significant
Decision making	0.28	9.93	0.076	0.9216	Significant
Human relations	0.34	9.91	0.120	0.8844	Significant
Marketing (product)	0.48	9.83	0.230	0.7696	Significant
Marketing (price)	-0.15	9.96	0.023	0.9775	Significant
Marketing (place)	0.66	9.59	0.440	0.5644	Significant
Marketing (promotion)	0.85	8.73	0.720	0.2775	Significant
Finance	0.41	9.87	0.170	0.8319	Significant
Accounting management	0.78	9.22	0.610	0.3916	Significant
Control	0.06	9.97	0.004	0.9964	Significant
Negotiation	0.28	9.94	0.076	0.9216	Significant
Venture launch	0.66	9.60	0.440	0.5644	Significant
Managing growth	-0.08	9.97	0.006	0.9936	Significant
Personal entrepreneurial skills:					
Inner control/disciplined (quantity)	0.23	9.95	0.055	0.9471	Significant
Inner control/disciplined (quality)	0.40	9.89	0.160	0.8400	Significant
Inner control /disciplined (time)	0.54	9.78	0.290	0.7084	Significant
Risk taker	0.67	9.57	0.450	0.5511	Significant
Innovative (product image)	0.65	9.62	0.420	0.5775	Significant
Innovative (new product)	0.78	9.21	0.610	0.3916	Significant
Innovative (new method)	0.61	9.69	0.370	0.6279	Significant
Change oriented	0.69	9.53	0.480	0.5239	Significant
Persistent	0.68	9.56	0.460	0.5376	Significant
Visionary leader	0.62	9.68	0.380	0.6156	Significant
Total	16.92			27.9302	Significant

According to Ghozali [15], construct reliability is calculated by the formula as follows:

Construct reliability = (Total of standard loading) / {(Total of standard loading) + Total measurement error}

Total of standard loading = sum of standardized estimation coefficients

Measurement error = 1- (standard loading)

Entrepreneurship construct reliability = (16.92) / (16.92) + (27.9302) = 0.91. Those value are higher than the recommended(0.70) Then the existing indicators on the entrepreneurship construct model conclusively be able to analyze the construct.

Table 2. Estimation results and business performance indicators significance (confirmatory analyses)

Indicator	S.E. Coeff.	t-value	R	Measurement error	Significance
Sales	0.68	7.48	0.46	0.5376	Significant
Profit	0.85	3.54	0.72	0.2775	Significant
Total	1.53			0.8151	Significant

Business performance construct reliability = (1.53) / (1.53) + 0.8151 = 0.74, then that particular construct is reliable. In another words, the entire indicator on business performance construct conclusively be able to analyze the construct.

4.2. Test results on capital as moderator variable.

SEM analysis results, presented in Fig. 2. Shows the standardize cooficient regression values to variable influence in the model and t-value for each influences between those variables.

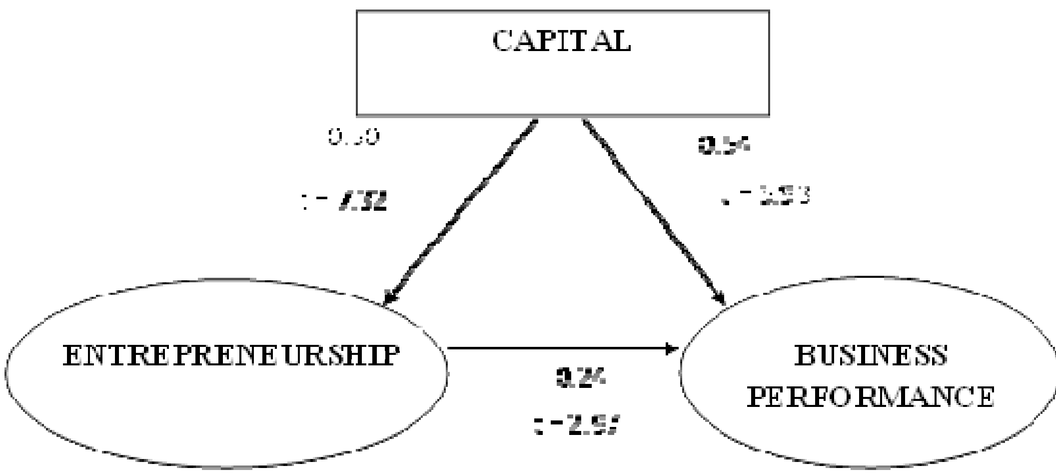

Fig.2. Standardized regression coefficient and t-value.

Hypothesis 1 Test Result : Capital Influence on Enterpreneurship.

The Regression equation acquired as follows:

Unstandardized regression :

$\eta_1 = 0.40^* \xi$ Errorvar = 0.51 $R^2 = 0.25$ (10)

(0.054) (0.078)

7.32 6.5

Standardized regression:

$\eta_1 = 0.50^* \xi$ (11)

On This case the Independent variable is capital on the other hand entrepreneurship is the dependent variable. Model performance shown by Chi-square value 3427.62, degree of freedom equal to 738, p-value 0,00000, and RMSEA= 0.135 . Thus it can be concluded that the model fit the data. Error for variable is shown by errorvar = 0.51 and determination coefficient of 0.25. The determination coefficient analyse that the variance could explain the 25 % by, as for the 75 % could be analysed by other variables outside the model. Regression coefficient on unstandardized regression is 0.4, while on standardized regression is 0.50, with t-value = 7.32 (while t-table on Distribution table 1 at is 1.86).

Thus the null-hypothesis is rejected, then the capital legitimately and convincingly have real effect (significant influence to) to entrepreneurship. That means that capital changes cause changes in the power of entrepreneurship with influence power of 0.50. Capital contribution towards entrepreneurship by (0.50)2 (100%) = 25%.

Hypotesis 2 and 3 Test Results.

The Regression equation acquired as follows:

Unstandardized:

$$\eta_2 = \underset{\substack{(0.062)\\5.93}}{0.37^*\,\xi} + \underset{\substack{(0.070)\\2.97}}{0.21^*\,\eta_1} \qquad \text{Errorvar} = \underset{\substack{(0.059)\\4.43}}{0.26} \quad R^2 = 0.48 \qquad (12)$$

From this test results could be seen that *unstandardized* regression is $\eta_2 = 0.37\ \xi + 0.21\ \eta_1$. On the other hand the *standardized* one is $\eta_2 = 0.54\ \xi + 0.24\eta_1$. Determination coficient value (R^2) of 0.48 means that total variance η_2 could be analyzed 48 % by η_1 and ξ , as the rest explained by other variables outside the model. In this model, entrepreneurship have a significant positive influence towars business performance since t-value (5.93) > t-tab ($\alpha_{0.05;198}$ = 1.86), with the greatest influence power of 0.24. Direct contribution of entrepreneurship towards business performance of $(0.24)^2$ = 0.0576 =5.76% .

Capital has a significant positive influence to business performance since t-value (2.97) > t-tab ($\alpha_{0.05;198}$ = 1.86), with influence strength = 0.54. Direct Influence of Capital to business performance of $(0.54)^2$ = 0.2916= 29.16 %.. Capital strengthen the influence of entrepreneurship to business performance, it showed by the indirect influence of capital toward business performance through entrepreneurship, with contribution of $(0.50)^2(0.24)^2$ = 0.0144 = 1.44%. Entrepreneurship is not aintervening variable, since capital indirect contribution to business performance (1.44%) is smaller than direct capital influence to business performance (29.16%).Based on these three tests, it could be concluded that capital is a moderator variable that strengthens entrepreneurship influence towards business performance.

5. Conclusion and Suggestion

5.1. Conclusions

Based on the results of precision test and analysis, it can be taken some conclusions as an answer to research question, as follows:

1. The capital is a moderator variable between entrepreneurship with small business performance. It means that changes in the capital used in the venture will cause changes on influencing power of entrepreneurship to business performance. Capital able to strengthen entrepreneurial influence on small business performance.
2. This study shows the presence of strong enough capital to entrepreneurship; however its moderation capability is still not maximal, since the lack of entrepreneurship on small businesses.
3. Factor that caused the weakness of entrepreneurship on small business is entrepreneur's skills still lacking. The scoring results of technical skills indicators, business management skills, and personal entrepreneurial skills demonstrated that in each of the indicators show that the score is not maximized, which is generally in position 3 from the maximum score of 5

5.2 Suggestion

Based on the conclusions and limitations of this study, it can be given several suggestions as the policy implications and directions for subsequent research, as follows:

1. The Government should not provide funds, but also need to work to improve the ability of small business in the access to capital. The government is expected to reduce required terms and simplifying procedures, and do full warrants for small business loans as most small businesses generally have difficulty in providing collateral. In this study 48% of entrepreneurs wish to access credit, but still experiencing these problems. There are only 2%of its business has been incorporated. There were 10% of small businesses that have made a good administration, and 40.% Have made a simple recording, and 50% have not.
2. In order to increase capital effectively in moderating entrepreneurship, trainings that could improve small business performance should be necessary. The training can be done by government or private parties that include three-dimensional skills (technical skills, business management skills, personal entrepreneurial skills), as well as other competencies. In this study only 4% of entrepreneurs who attended the training
3. In addition to capital and entrepreneurship, there are other variables that need to be investigated its effect on small business performance that are external factors and internal factors. External factors such as input and output structure markets, government policies, infrastructure, technology, labor, and others. Internal factors such as education, business experience, age, culture, and so forth.
4. Information value of the results of this study shall improve if in the future a re-study could be done, in order to obtain a time-series studies. Thus, could be seen whether or not there a better change of direction, and success factors and barriers can be known.

References

[1] Alisjahbana. Armida S. FaktadanStrategiPengembanganIndustriMakanandanMinuman di Indonesia.*JurnalKeuangan Negara*; 2009; 1: 19-47.
[2] Widi, Nugroho. *InformasiKredit Usaha Kecil.* Jakarta: PT PustakaBinamanPressindo; 1997. (Bab 1).
[3] Indonesian Small Business Research Centre dan LP3E- Kadin. *Usaha Kecil Indonesia: TinjauanTahun 2002 danProspekTahun 2003*. Jakarta; 2003.(Bab 5).
[4] Undang-Undang RI No 20 Tahun 2008 tentang Usaha Mikro, Kecil, danMenengah.
[5]Zimmerer, Thomas W., and Norman M. Scarborough. *Essentials of Entrepreneurship and Small Business Management*, International Edition. (4th ed.). New Jersey: Pearson Education; 2005. (Chapter1).
[6]Gregory, Brian T., Matthew W. Rutherford, Sharon Oswald, and Lorraine Gardiner. An Empirical Investigation of the Growth Cycle Theory of Small Firm Financing. *Journal of Small Business Management*; 2005; 43: 382-392.
[7] Aspiranti, Tasya."Asymetric Information on Non-bank Microfinance Institution in Lending to Micro and Small Enterprise".*Proceeding of The 3rd Indonesia International Conference on Innovation, Entrepreneurship and Small Business 2011.Creative and Cultural Entrepreneurship in the New Era*.pp.207-214.Bandung: School of Business and Management, InstitutTeknologi Bandung, Indonesia; July 26-28; 2011;
[8]Siropolis, Nicholas. *Small Business Management a Guide to Entrepreneurship*.(5th ed.). Boston: Houghton Mifflin Company; 1994. (Chapter 12)
[9] Hisrich, Robert D., and Michael P.Peters. *Entrepreneurship: Starting, Developing, and Managing A New Enterprise*. (3rd ed.). Boston: The Mc.Graw-Hill, Inc.; 1995. (Chapter 1 and Chapter 2).
[10]Meredith, Geoffrey G. Robert E. Nelson, Phillip A.Neck. *Kewirausahaan: TeoridanPraktek.*(*The Practice of Entrepreneurship*. Translator: Andre Asparsayogi). Jakarta: LPPM dan PT PustakaBinamanPressindo; 2005. (Bab 7).
[11] Ghosh, B.C., Teo Sock Kim and Low AikMeng. "Factors Contributing to the Success of Small-and Medium-Size Enterprises in Singapore".*Entrepreneurs, Entrepreneurship and Enterprising Culture*(LoeAikMeng& Tan Wee Liang), (pp.30-46). Singapore: Addison-Wesley Publishing Company, Inc.; 1996.

[12]Horngren, Charles T., George Foster, and Srikant M. Datar. *Cost Accounting A Managerial Emphasis*. (10th ed.). New Jersey: PrenticeHall, Inc.; 2000.(Chapter 3).
[13] Hatten, Timothy S. *Small Business: Entrepreneurship and Beyond*. (International ed.). New Jersey: zrentice-Hall Inc., A Simons & Schuster Company; 1997.(Chapter 2).
[14] Miller, Roger Le Roy dan Roger E. Meiners. *TeoriEkonomimikro Intermediate* (*Intermediate Microeconomics*. Translator: HarisMunandar) Jakarta: PT Raja GrafindoPersada. 1993. (Bab 11).
[15]Ghozali, Imam. *Model PersamaanStruktural*. Semarang: BadanPenerbitUniversitasDiponegoro; 2004. (Bab X dan Bab XI).
[16] Sauer, Paul L., and Alan Dick. “Using Moderator Variables in Structural Equation Models", *Advances in Consumer Research*. (Leigh McAlister and Michael L. Rothschild). Provo, UT : Association for Consumer Research; 1993; 20: 636-640.
[17] AchmadBachrudindanHarapan L. Tobing.*Analisis Data UntukPenelitianSurvai: DenganMenggunakan LISREL 8, DilengkapiContohKasus*. Bandung: JurusanStatistika FMIPA- Unpad; 2003. (Bab 3).

C. Implementation of Triple Helix Model In Entrepreneurship

RESEARCH-BASED ENTREPRENEURSHIP

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Abstract
These days, a lot of people believe that entrepreneurship will become one of the solutions in order to increase welfare level in Indonesia. If an entrepreneurship really plays the role as a solution to increase welfare level in Indonesia, the next question would be: how to realize it? One of the real implementation way is by using Research-based Entrepreneurship that has been commonly implemented by developed country. The success of implementing Research-based Entrepreneurship depends on the harmonic collaboration between government, academician which represents university party, and entrepreneur which represents industry party. These three integrated components also well-known as triple helix. The government will provide fund, regulation and other any support that needed to be maximized by academician in university in order to create some breakthrough researches that will end up with some outstanding innovative results or patents. And this research result then will be commercialized by an entrepreneur so that it can be a mass product that will have a positive impact to society. The strong collaboration of triple helix in the cycle of Research-based entrepreneurship is able to create sustainable innovation that can support the economic movement in their country and also improve the people‟s welfare in the same time.

As the comparison study, this paper suggested the essence of the research-based entrepreneurship that implemented in some developed country. Then, researcher would like to suggest the red line that comes up as the conclusion from the research that already done in this paper. Researcher believed the research in this paper could be proper foundation in order to start implementing Research-based Entrepreneurship in Indonesia.

Keywords: Triple-helix, Research, Entrepreneurship

1. INTRODUCTION

These days, a lot of people believe that entrepreneurship will become one of the solutions in order to increase welfare level in Indonesia. One of entrepreneur figure, David McClelland said that a country will be prosperous if it has entrepreneurs at least two percent from its citizen (Ciputra, 2008). It is hoped that these hand of entrepreneurs may give social impact to its society by increasing society welfare around them. Thus, entrepreneurship will become motor for National economy resurgence in general.

Talking about entrepreneurship, there are some misperceptions which spread among people. In the end, these misperceptions of entrepreneurship may create mistakes which can influence the will of society to become an entrepreneur. On of them is the perception that entrepreneurship is about beginning and running small business (Morris, 1998). On the other hand, lot of small scale business in fact do not represent the spirit of entrepreneurial like was said before. The closest thing to it when they began and opened their business in the beginning, then by the time runs they began to reach stagnancy and losing its dynamism. Entrepreneurship is needed to be seen universally by every single person, organization, and a nation.

Rather than focusing on the quantity of business enterprise, innovation has been proven to play an important role for entrepreneurship field. One of the most successful entrepreneur in Indonesia, Ciputra, has suggested that an Innovation as one of the three important things during entrepreneurship activity (Ciputra, 2008). In this world, some country had blessed with a lot of natural resources. But, without an entrepreneurship spirit, this advantages had proven did not give any significance improvement to their society�s wealth condition. On the other hand, some country which is actually resource less, using their entrepreneurship spirit and supported with other things such as good work ethic and other, they can improve their economy better and faster than the country that has a lot of resources and give a better prosperity for their citizen.

If an entrepreneurship really expected to be a solution to increase welfare level in Indonesia, the next question would be: how to realize it? In this paper, researcher suggest the Research-based Entrepreneurship that has been commonly implemented by developed country as a key point of entrepreneurship-driven-country. The success of implementing Research-based Entrepreneurship depends on the harmonic collaboration between government, academician which represents university party, and entrepreneur which represents industry party, which is also well-known as triple helix.

2. ENTREPRENEURSHIP & INNOVATION

The word “entrepreneurship” was first introduced in 1755 by France economy expert from Scotland, Richard Cantillon. In *Essai sur La Nature du Commerce en General*, he defined entrepreneur as they who pay certain price for certain product, to be sold with uncertain price, while making some decisions about how to gain and use sources and taking business risks (Ciputra, 2008).

One of modern entrepreneur academic figure, Raymond W.Kao, said that entrepreneurship is “*the process of doing something new (creative) and something different (innovative) for the purpose of creating wealth for the individual and adding value to society*” (Tan, 2002). From the fragment of definition above Kao underlined that entrepreneurship has to do something creative and innovative and also has pervasiveness factor, which can give positive effect to welfare of personal and surround society. This has similarity with Michael H. Morris‟ opinion, that someone with entrepreneurial ability includes 3 main dimensions, *innovativeness, risk-taking and proactiveness*. I*nnovativeness* includes the ability to find creative solutions, uncommon and out of general to solve problems and needs. Entrepreneurship is the process through which innovations become enterprise that produce value. It is how new ideas become concrete and affect people's lives (West, Gatewood, and Shaver, 2009).

In Indonesia, one of figure who cares about the increase of entrepreneurship in Indonesia, Ciputra, gave simple and easy to be understood definition of entrepreneurship. Ciputra defines entrepreneur as someone whose experience is becoming entrepreneur for years. Ciputra said there are three main things on the process to change „waste‟ and „wreck‟ to become “gold”, *Opportunity Creating, Innovation* and *Calculated Risk Taker* (Ciputra, 2008).

3. THE EEL OF TRIPLE HELIX

There is a term called the Triple Helix in the activity of entrepreneurship. Triple Helix is the three main motors of creativity, ideas, knowledge and technology which is vital to the increase of creative industry (Depdagri, 2008). The third part of the Triple Helix is Education, Entrepreneur and Legislative. We can see the interaction pattern of the three parties in EEL concept below.

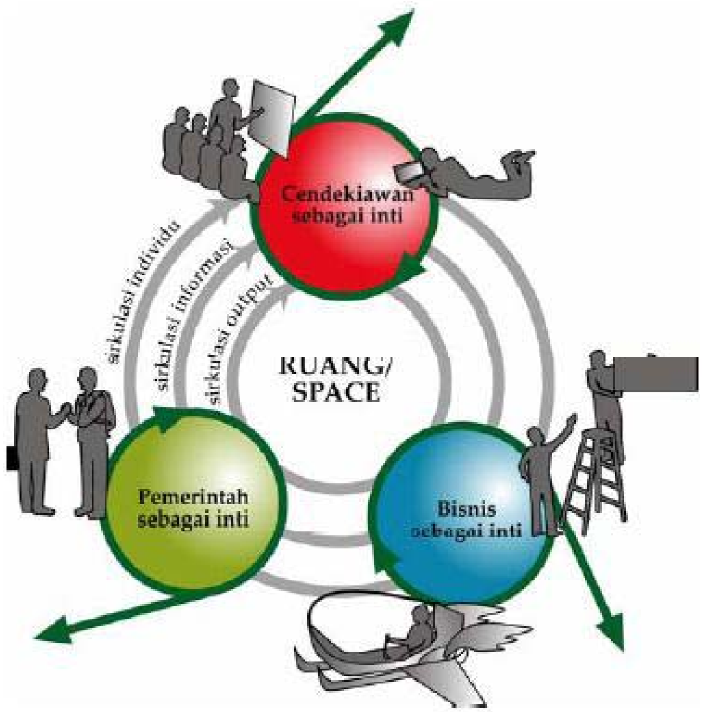

Figure 1. The EEL of Triple Helix

Education consists the experts who has main interest to search for satisfaction in processing art, knowledge of metaphysic speculation, and not to find practical purposes, and also thy who has point of view and activity of rebel toward mass realism (Depdagri, 2008). They are the scientists, philosophers, artists, metaphysic experts who find their satisfaction in the application of knowledge (not in the result of it). The thing of this expertise is also given by the willingness to implement knowledge and to spread it. The experts have huge capacity in strengthen formal and informal bases of innovation, and has ability to ripen the concepts of innovation and to disseminate information using international network.

If we see it from economy aspect, entrepreneur or a company is an organization�s entity which is formally recognized and created in purpose to provide things from products to services for customer (Depdagri, 2008). A company is usually owned by private and build to gain profit and increase the welfare of the owner. Entrepreneur have purpose to gain financial profit as their working result and also challenge risk they have to face.

Legislative is defined as an organization which has authority to manage a nation, as one policy, or it is a national device which has foundation that can functionalize and use the authority or power (Depdagri, 2008). Thus, legislative has the authority to create and implement laws and statutes in certain territory.

From the explanation of the chart above, we may see that Education is the main pole which motorizes creativity and innovation in the act of entrepreneurship of a nation. Thus, it is no longer surprising if in developed country, legislative never doubt to trickling huge amount of fund to their universities. This research fund is expected to afford research output which can be useful for society and mentioned country.

In the effort to spread that research result massively, the role of entrepreneur becomes very important and crucial. This is what we called Research Based Entrepreneurship, an activity of entrepreneurship based on comprehensive research to create useful innovation. If development is freedom, then so too is entrepreneurship. Indeed, to conceive an idea, to give that idea sustaining life by making it into an enterprise, and then to have that enterprise yield benefit for yourself and others is distinctive type of freedom (West, Gatewood, and Shaver, 2009)

4. RESEARCH BASED ENTREPRENEURSHIP

Every year, all of nations makes budgeting plan which will be used in their national activity. As one of the super power nation in the world, from huge budget which had provided, United States budgeting 50% of it to defense sector and army, 25% from it is for *health and human service* including education and the rest is for other sectors such real estate, et cetera.

With this huge budget, it is no longer surprising if the center of research in universities or independent research basis can make a lot of creative and innovative result. A lot of foundations also even fund researches out of United States to do certain observation. The result of the researches later will come back to the United States to be observed deeper that can be implemented massively among society, in case it provides the fund.

Something interesting also came from South Korea. The government of South Korea, through *Korea Research Foundation* (KRF) which ensconce under its education department, funds not less than 290 billion Korean Won (currency 1 Won = Rp. 8, +/- Rp. 2,3 Trillion) per year to motorize research activities in their universities. That fund includes education research expense that is given to center of researches under KRF.

From this research fund, the center of research which leaded by a professor and has members of students from *undergraduate* to *graduate* shall run its research activities. Besides, KRF also has simple working system, efficient yet still under control. As an example, for each approved research proposal, professors will be given credit card that can be used according to the approved fund. Memorizing a lot of software and hardware which usually can be bought by online, using credit card is a simple yet smart solution. It is not difficult to do liability in this case since the trace of transactions will be recorded in KRF correspondence bank. Beside of the purchasing of devices to support the research, the fund is also given in term of monthly allowance to professor who lead the lab, to students in it to pay for their trip if their researches are published on conferences.

From these scientific laboratories, al lot of innovative works emerge and given to this country or to be used by core companies such as Samsung and LG to be used massively to increase the welfare of the society. Neither in United States nor South Korea, massive production phase becomes very important that innovation which created in a research laboratory can give massive function. Besides, massive production increase has to be in the same line with the increase of the working field.

This is the core of *Research-based Entrepreneurship*. If the entrepreneur is the real representation of entrepreneurship spirit, activity which done had to be more then just whole stocking. Something creative and innovative does not suddenly come from the sky, there is a process which has to be passed to make an innovation can be used in daily life. Research activity is one of the process that can be done in the activity chain of entrepreneurship.

5. DISCUSSION

From the explanation above, there are three main components in *Research-based Entrepreneurship*, they are Government, Academic people, and Entrepreneur. However, the government as the “parent” which stands for its citizen including academic people in universities or entrepreneur has to provide funds, support and conducive condition to run research activity with good quality. Funding is an important thing in research activity series. If the funding which provided is always got corrupted and used by wrong parties, the amount of it shall be decreased from the expectation that the quality of the of the research shall be decreased as well. Besides, the support of government also can be shown by implementing simple and efficient working system that the academic people will not be burdened by complicated and overload documentation and still focused on their research.

Last, government has to create harmonic condition. Harmonic condition has to be kept from the beginning of the research until it is the time to give the result of the research back to the country or entrepreneur, that the function of the result of the research can be used massively by society. How effective is the *Research-based Entrepreneurship* will be much according to the synergy of its three main components, Education, Enterprise and Legislative. Good initiation, responsive and full of responsibility were needed by the government as the operator of national life. If the *Research-based Entrepreneurship* runs well, the government shall feel pleasure to see its citizens have better life and welfare. This is the real responsibility of the government to increase citizen□s welfare and one of the step is by using entrepreneurship.

References

Baron, B.A., and S.A. Shane. 2005. *Entrepreneurship, a Process Perspective.* Ohio : South-western.
Ciputra. (2008). *The Quantum Leap.* Jakarta : Elex Media Komputindo.
Dolliner, M.J. 2003. *Entrepreneurship 3rd Edition*. New Jersey : Pearson Education
Fayolle, A. 2007. *The Dynamic of Entrepreneurial Process.* New York : Cambridge University Press
Hair, J.F., et al. 2006. *Multivariate Data Analysis 6th Edition.* New Jersey : Pearson Education
Henry, C. (2008). *Entrepreneurship in The Creative Industries.* Edward Elgar Publishing
Herbert, R., and A.Link. 2009. *A History of Entrepreneurship.* New York : Routledge
Lesierre, P., 2007. *Global Strategic Management.* New York : Palgrave Macmillan.
Liang, T.W. (2002). *The Dynamics of Entrepreneurship.* Prentice Hall

Malhotra, Naresh. K, 2004. Marketing Research : An Applied Orientation, New Jersey Prentice Hall International Inc.
Morris, H. 1998. *Entrepreneurial Intensity.* Westport : Quorum Books.
Rae, D. 2007. *Entrepreneurship, From Opportunity to Action.* New York : Palgavre Macmillan.
Timmons, J.A., and S.Spinelli. 2009. *New Venture Creation, Entrepreneurship for The 21st Century.* New York : Mc.Graw Hill.
Welsch, H.P. 2005. *Entrepreneurship, The Way Ahead.* New York : Routledge.
West, Gatewood, and Shaver (2009). Handbook of University-wide Entrepreneurship Education. Edward Elgar Publishing Limited, USA

ENTREPRENEURIAL CAPABILITIES AND ORGANIZATIONAL TRANSFORMATION: THE CASE OF THE COORDINATION ENGINEERING GRADUATION PROGRAMS IN THE FEDERAL UNIVERSITY OF RIO DE JANEIRO

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Abstract

Brazilian government has been fostering innovation through a series of policies aiming the technology transfer from public funded science and technology organizations to the market. One of the responses to this initiative has been an attempt on the part of some universities to transform themselves into entrepreneurial institutions. In this paper we develop a longitudinal case study to analyze the organizational transformations faced by a particular academic unit (COPPE) of a Brazilian university (UFRJ) in order to perform an entrepreneurial role. Our analysis is focused in the entrepreneurial capabilities developed by this academic unit, we found that the main capabilities are: (i) managing university interfaces with external actors; (ii) integrating public policy initiatives; (iii) supporting entrepreneurial activities; (iv) technology transferring; (v) managing sharing resources. These five capabilities have been developed in three different levels of maturity: basic, intermediary and advanced. The development of these entrepreneurial capabilities happens in tandem with the organizational transformation process of the university.

Keywords: Academic entrepreneurship; organizational transformation; capabilities.

Abstract

Brazilian government has been fostering innovation through a series of policies aiming the technology transfer from public funded science and technology organizations to the market. One of the responses to this initiative has been an attempt on the part of some universities to transform themselves into entrepreneurial institutions. In this paper we develop a longitudinal case study to analyze the organizational transformations faced by a particular academic unit (COPPE) of a Brazilian university (UFRJ) in order to perform an entrepreneurial role. Our analysis is focused in the entrepreneurial capabilities developed by this academic unit, we found that the main capabilities are: (i) managing university interfaces with external actors; (ii) integrating public policy initiatives; (iii) supporting entrepreneurial activities; (iv) technology transferring; (v) managing sharing resources. These five capabilities have been developed in three different levels of maturity: basic, intermediary and advanced. The development of these entrepreneurial capabilities happens in tandem with the organizational transformation process of the university.

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1. Introduction

This paper analyses the organizational transformation process and the development of entrepreneurial capabilities in universities. A case study of a particular Brazilian university is presented to reflect the new pattern of action, connected with the evolution of the science, technology and innovation (S,T&I) institutional environment in Brazil. Over the past two decades researchers and policy-makers have increasingly acknowledged the importance of universities and other publicly financed research organizations as engines of knowledge-based growth and enhanced innovative performance in developed economies.

Universities are conceptualized as creators and providers of knowledge spillovers for industrial innovation and thus as key actors in the national and regional innovation systems. Particularly the triple helix narrative has been widely heralded as the new policy paradigm that puts universities at the heart of knowledge-based regional economic development (Jacob et al, 2003).

It explicitly seeks to reform academia into entrepreneurial universities and to strengthen industryuniversity-state interaction. Under this paradigm, it is believed that in order to harness scientific knowledge for innovation, industry-university linkages have to be stimulated through various mechanisms such as the promotion of academic

entrepreneurship, the establishment of science parks and incubator centers and the set-up of a technology transfer support infrastructure.
Jacob et al (2003) indentify that the entrepreneurial university encompasses commercialization (e.g. custom made further education courses, consultancy services, extension activities) and commodification (e.g. patents, licensing, faculty or student owned start-ups). These initiatives have given rise to the phenomenon of the entrepreneurial university (Clark, 1998; Etzkowitz, 2002). Entrepreneurial activities can be defined as activities that center on the identification and exploitation of opportunities (Zahra et al., 2006).
The entrepreneurial university is a term used to refer to universities which possess a wide range of new infrastructural support mechanisms for fostering entrepreneurship within the organization as well as packaging entrepreneurship as a product. In addition, the entrepreneurial university encompasses technology transfer activity and the promotion of joint R&D projects between enterprises and the university through technology parks.
The policy language is filled with optimistic narratives about universities being bridgeheads of innovation in the knowledge society; the examples of MIT and Stanford are often mentioned as models to be followed by others. The reality of building an entrepreneurial university however, is an arduous task for which there is no blueprint. Etzkowitz (2002) shows that the raise of the entrepreneurial science is an accumulation of many years work. In the case of MIT the author shows that the entrepreneurial orientation is the result of almost one century of work.
In order to play this entrepreneurial role, universities need to develop specific capabilities. Rasmussen & Borsch (2010), analyzing two universities in Norway, found that three key capabilities influence the spinoff formation: (i) creating new paths of action; (ii) balancing both, academic and commercial interests; (iii) integrating new resources. In our research we have used a broader scope of analysis, focusing academic entrepreneurship that involves not only spin-offs formation but also technology transferring and the technology park.
Another key difference is that in our approach we have used a dynamic perspective that leads us to the identification of five capabilities that were developed in three different levels of maturity: basic, intermediary and advanced. We also have identified that there is a connection between the development of these capabilities and the organizational transformation process faced in the case study that we have analyzed.
The paper is structured as follows, in the next section we present the methodology used in the study, in section 3 we present the data and findings, the academic entrepreneurship context in Brazil, the organizational transformation process faced by the academic unit that we have studied and the entrepreneurial capabilities developed by this academic unit.

2. Methodology and case contextualization

The approach taken to data collection for this study has been qualitative. A longitudinal case-study was chosen to analyze the organizational transformation process faced by COPPE/UFRJ in the last 20 years in order to perform an entrepreneurial role in the technology transfer process. This approach provides a richer contextual insight and an in-depth understanding of this dynamic and complex analysis. The study attempted to answer the following questions: What are the main organizational transformations faced by COPPE/UFRJ in order to perform an entrepreneurial role? What are the key capabilities required for this performance? How these capabilities were developed?

2.1 Case selection and sample

Select COPPE/UFRJ as a single case is appropriate for different reasons. First, the analysis proposed in this study requires a detailed intra organizational understanding of the process involved. Second, COPPE is the biggest infrastructure of teaching and researching of engineering from Latin America. The specialized literature recognizes that there is a stronger impetus of spin-offs formation and technology transfer at Universities that perform science of excellence (Shane, 2004). Third, other researchers have successfully used single site studies to increase understanding about particular issues related to technology transfer and spinning out ventures (Shane & Stuart, 2002; Jacob et al. 2003; Moray & Clarice, 2005).
The data we have analyzed were focused in the organizational instruments used by the university to perform an entrepreneurial role such as the business incubator, the technology transfer office and the technology park. Our analysis also includes the main outputs of these organizational instruments such as technology based spin-offs, licensing of patents and joint R&D projects carried in the technology park.

2.2 Methods and research steps

Primary and secondary data were used to develop the longitudinal case study (Yin, 1989). Data triangulation including several sources of data was used to map out the situation and critical events in the organizational transformation process towards an entrepreneurial orientation in COPPE/UFRJ. From 2004 to 2012 people from various positions were interviewed, including several interviews with the directors and managers of the business incubator, the technology transfer office and the technology park. We also collected primary and secondary data about the main outputs of the entrepreneurial orientation of the university, the spin-offs, the patents licensed and the R&D projects carried in the technology park.

Our study starts with data collection in secondary sources about the university and its entrepreneurial activities. In this phase we have analyzed the web sites of the university, the business incubator, the technology transfer office and the technology park. In addition we also have checked the web sites of the 30 spin-off companies identified in the database of the business incubator. The information that we have collected in this phase includes a small brief of each company and the name and contacts of the founders. We also analyzed the database of the technology transfer office and had access to a set of information about successful and unsuccessful cases of technology transfer.

After this initial phase we performed in depth interviews with the directors and managers of the business incubator, the technology transfer office and the technology park. These interviews had two parts, the first one devoted to the analysis of the organizational transformation process of the university and the second one devoted to the analysis of the outputs of this entrepreneurial orientation. The secondary data collect in the first phase were used as a guideline for the comments of the respondents. In total we have carried ten interviews with six key managers of the entrepreneurial activity in the university.

2.3 Contextualization of the case study

The change in the Brazilian innovation institutional environment was very intense over the decade of 2000. In 2004 it was approved the innovation law, that regulates the public and private interface regarding to science, technology and innovation activities. The Brazilian innovation law has three central pillars: (i) all federal universities must establish technology transfer offices that are responsible for managing intellectual property in the academic context; (ii) sharing of infrastructure, physical and human resources, between public universities and private enterprises is allowed; (iii) public agencies can grant investments for R&D activities in private companies.

In 1999 comes into operation a new funding policy for S,T&I activities, the "sectoral funds". These are funds focused on specific sectors such as petroleum, electricity power, telecommunications, mineral resources, among others. The resources that feed these funds come from taxes paid by companies in each sector. There is a commission formed by members from the industry, university and government that defines the guidelines for the investments in each fund. There is also one fund that promotes cross sector projects in cooperation between universities and companies. This new funding system is a milestone of the Brazilian innovation policy; it links the science and technology within industrial policy. The annual budget for science and technology activities in Brazil significantly increased between 2000 and 2009, from U$ 5 to U$ 15.8 billion (MCT, 2011).

With the Innovation Law and the set up of a new funding system the Brazilian government is trying to create a friendlier environment for innovation activities, but the real picture is still disappointing. Most of the science and technology infrastructure in Brazil is still concentrated at the public universities. From 1996 to 2008 around 87.000 of PhD were formed in Brazil, 90% in public universities, 12% in engineering. The biggest part (71%) work in educational activities, only 2% work in the industry and other 4% work in the scientific consulting sector (CGEE, 2010). In this context Brazilian universities are passing trough organizational transformations in order to perform an entrepreneurial role.

The main transformations that the universities are passing by include the establishment of business incubators, technology transfer offices and technology parks (Etzkowitz et al 2005). These three organizational mechanisms flourish over the last two decades in most of the Brazilian universities. The number of business incubators has grown sharply, the first one was establish in 1988, ten years latter there were 74, in 2001 there were 150 and nowadays there are some 400 business incubators operating in Brazil (ANPROTEC, 2012). Not all of these incubators are linked to universities but almost all universities operating in Brazil have a business incubator.

The number of technology transfer offices (TTOs) is also increasing very fast, by 2005 there were 30 TTOs operationg in Brazil (Lahorgue et al 2005), nowadays there are 192 TTOs linked to the national association technology managers (FORTEC, 2012). The biggest part of these TTOs is connected to public Universities and research institutes. The evolution of the technology parks in Brazil is another aspect of the science and technology policy. In 2000 there were 10 technology parks operating in Brazil, in 2005 there were 25 and in 2008 there were 74 (ANPROTEC, 2012). The government has been supporting all these mechanisms in the last decade.

The phenomenon of incorporating new organizational mechanisms in Brazilian universities in order to perform an entrepreneurial role is a national wide movement. As entrepreneurial role we mean the activities that universities perform to promote the capitalization of the knowledge produced in the academic context and its transfer to the market. The case of COPPE/UFRJ is a successful one in the national scenario and illustrates the complexity involved in the organizational transformation process of the university and the development of entrepreneurial capabilities in the academic context.

3. Entrepreneurial capabilities and organizational transformation: the case of COPPE/UFRJ

This chapter is divided in tree subsections; the first one is devoted to presenting an overview about the trajectory of COPPE, since it's creation in 1963 until nowadays. In the second one we present an overview and an analysis about the organizational transformation process faced by COPPE/UFRJ in the last two decades in order to perform an entrepreneurial role. In the last subsection we present an analysis about the development of entrepreneurial capabilities at COPPE/UFRJ and its connection with the organizational transformation process.

3.1 – The Coordination of Engineering Graduation Programs (COPPE/UFRJ)

The Coordination of Engineering Graduation Programs in (COPPE) is the largest academic unit of the Federal University of Rio de Janeiro (UFRJ). The UFRJ is the biggest federal university in the country with 28 teaching units, offering 145 courses to 33,300 undergraduate students. It has about 3,800 teachers of whom approximately 2200 have a doctorate degree. The scientific activities are part of the routine of the university with 85 graduate programs that offer 85 MSc and 74 PhD courses. All these research activities degree 1500 MSc and 720 PhD per year (UFRJ, 2011).

COPPE/UFRJ hosts 12 graduation programs in engineering: Biomedical, Civil, Chemical, Electrical, Computer, Metallurgy / Materials, Nuclear, Mechanical, Transportation, Production, energy planning and Oceanic. All the 12 graduation programs have a good evaluation in the national ranking carried by the ministry of education (CAPES, 2012). This is the biggest infrastructure for teaching and research in engineering in Latin America, with about 2800 graduation students (1600 MSc and 1200 PhD), 350 collaborators (325 full equivalent researches) working in 116 research laboratories. In 2010 about 176 PhD and 344 MSc students were degree at COPPE. Since it's creation in 1963, COPPE has degreed some 12,000 MSc and PhD students in engineering (COPPE, 2012).

The Coordination of Engineering Graduation Programs in the Federal University of Rio de Janeiro was created in the 60s as a result of an effort to improve the level of human resources in technology based areas. In the same period it was establish inside the campus of UFRJ the R&D center of the government oil company (Petrobras / CENPES) and the National Research Institute in Nuclear Engineering (IEN). In the next decade another two R&D centers were established inside the campus of the university, one from the government company of electricity power (Eletrobras / CEPEL) in 1974 and another one in Mining and Minerals Technology in 1978 (CETEM).

During the 70s and 80s the engineers from COPPE were involved in consulting services mainly for government companies from utilities and strategic sectors such as oil, electricity power, nuclear engineering, mining and minerals technology, among others. These consulting services lead to the creation, in 1970, of a department specialized in project management, The Coordination of Projects, Research and Studies in Technology (COPPETEC) that was converted in a foundation with the same name in 1993 (TERRA, 1999). Since the creation of COPPETEC there were some 10,000 projects managed by the department and latter the foundation. Nowadays there are 600 active projects with a total budget of U$ 135 millions in 2008 (COPPETEC, 2012).

In the mid 80s there were a project carried by the National Council for Research and Development (CNPq) aiming the creation of nuclei of technology based innovation in some universities, COPPE was one of the projects that received the support from CNPq. At this time it was not clear what would be the role of the university in the innovation process and what would be its scope of action. In this same period, the Brazilian Innovation Agency (FINEP) starts a project aiming the mapping of initiatives related to technology parks and business incubators in Brazil, COPPE was part of this project. These two government projects carried in the mid 80s were the roots of the business incubator, the technology park and the technology transfer office inside COPPE/UFRJ.

3.2 – The organizational transformation process at COPPE/UFRJ: towards an entrepreneurial role

In parallel with the project supported by CNPq and FINEP in the mid 80s, two collaborators of COPPETEC (Mauricio Guedes and Regina Faria) start a new project to implement a business incubator inside COPPE/UFRJ. The Business Incubator of COPPE was founded in 1994 after long 8 years of discussion. There were some resistance inside the university and the process for the official creation of the business incubator was very bureaucratic. By 1992, even without the official creation, the members of COPPETEC involved in the business incubator project decide, with the support of the directory of COPPE, to carry the first call for projects to be incubated.

As the business incubator didn't have a physical infra-structure already, the first project was incubated inside the administrative facilities of COPPE/UFRJ in a provisory fashion. Once they had the first start-ups to be supported and the perspective to be official approved by the university, the team starts to search for resources for the construction of the appropriate infra-structure for the business incubator. In the early 90s Mauricio Guedes had visited several potential partners for the project such as the Brazilian Innovation Agency (FINEP) and the city hall of Rio de Janeiro. He got the funds to build the facilities integrating initiatives of public policy from different sources.

After this first phase of the incubator concerns about the sustainability of the project start to emerge. The challenge was to find a way to keep a team working in a full time basis to provide a better support for the start ups. The solution came with the support of the Brazilain Service of Support for Small and Medium Enterprises (Sebrae). Nowadays the incubator has facilities of 1900 m2 of built area with current 15 incubated start-ups, since its creation there were 58 start ups supported. The operational model used in the incubation process involves the provision of physical infrastructure and consulting services in the areas of finance, accounting, law, marketing and design.

The technology park was created in 1997 as a continuation of the business incubator project, carried by the same team. The university council grants an area of 347.000 m2 inside the campus for its implementation. From 1997 until 2003, the date of the inauguration of the park, the efforts were concentrating in funding rising for the urbanization of the area. In this same year occurs the inauguration of the first laboratory of the Technology Park, the Laboratory of Ocean Technology (LabOceano). It is a laboratory linked to the university that was designed to offer specialized services for the oil industry. From 2003 to 2007 the team of the technology park starts a strategy to attract small companies from the Energy, Information Technologies and Environment sectors. The strategy wasn't successful once the small companies didn't have the appropriate resources to invest in the construction of R&D centers inside the technology park.

In 2007 the Brazilian government announces the discovery of new reserves of oil in deep waters. There is no technology available to pump this oil and a series of technology challenges emerge from this market scenario. Petrobras announced an investment of U$ 250 billions and many other private companies start to show interest to install their R&D labs inside the campus of UFRJ, near COPPE and near the R&D center of Petrobras, CENPES. In this new context the team of the Technology Park managed to raise new funds from multiple sources from public and private spheres; the city hall, the state government, the federal government and the companies that want to establish their R&D centers inside the technology park. From 2008 to 2012 several companies have announced investments in the technology park, this list includes Petrobras, Schlumberger, Halliburton, FMC Technologies, Siemens, BG Group, Genral Eletric, among others.

According to the interviews carried with the team of the technology park, this was a turning point in the trajectory of the university towards an entrepreneurial orientation. It was the first time that there were private companies' interest in investing in R&D initiatives within the university. Some conflicts emerge from this new scenario, the companies that want to establish their R&D lab inside the technology park had to build the facilities without having the property of the land; they got a twenty year concession. This negotiation was very hard and completely new for the university managers. Another conflict that emerges from this scenario is the overlap of the university infra-structure and human resources and the private laboratories that the companies are locating inside the campus. The management of intellectual property becomes much more complicate in this scenario.

Historically the discussion of having an official intellectual property policy wasn't restricted to COPPE, it was a discussion inside UFRJ as a whole. According to the interviews the proposal of COPPE having its own intellectual property policy wasn't accepted by the central administration of UFRJ. Since the 80s there were discussions about this issue but only in 2001 is that it was created the Coordination of Intellectual Property Activities, which was replaced in 2004 by the Division of Intellectual Property and Technology Transfer (DPITT). The main difference among both initiatives is that the first one was focused in the protection of the intellectual property inside the university, while the second one was also concerned with the licensing of the intellectual property and its capitalization in the market.

3.3 – The development of entrepreneurial capabilities at COPPE/UFRJ

The development of entrepreneurial capabilities at COPPE took place in tandem with the organizational transformation of the university. The first one that we have indentified in our research is the capability of managing the university interface with external actors. The development of this capability was associated with the creation of COPPETEC, an important organizational transformation in COPPE towards its entrepreneurial role. Since the 70s the interaction with external actors was going on at COPPE, the creation of COPPETEC came in order to make this process more efficient.

The experience of COPPETEC is in the roots of the creation of the business incubator, the technology park and the UFRJ Agency of Innovation. In the Brazilian institutional context the public policies for science, technology and innovation have multiple sources. In order to acquire the resources for the entrepreneurship support, technology transfer activities and the technology park, the university must know how to integrate different public policy initiatives. The business incubator was installed in 1994, the resources for its operation came from three different

government agencies (CNPq, FINEP, FAPERJ), one non government organization (SEBRAE) and from the city hall of Rio de Janeiro. The implementation of the technology park and the innovation agency also have followed the same pattern and had multiple sources of resources. All the three experiences of the implementation of the business incubator, the technology park and the technology transfer office are connected to the capability of integrating public policy initiatives, the second one that we have identified in our research.
Upon the capabilities of managing the university interface with external actors and integrating public policy initiatives other two capabilities were developed. With the implementation of the business incubator it was developed the capability for entrepreneurship supporting and with the implementation of the agency of innovation it was developed the capability of technology transferring. With the implementation of the technology park a fifth capability was developed: managing of sharing resources. With the evolution of COPPE/UFRJ towards an entrepreneurial orientation, sharing resources start to emerge. This phenomenon was connected with the location R&D labs from big companies and technology based start-ups in the campus of UFRJ. This transformation starts with the set up of the technology park, in 2008. Global companies like Petrobras, Schlumberger, Halliburton, Siemens, BG Group and Genral Eletric have their R&D labs located inside the university.
This companies share resources with the university, physical resources in the case of laboratories, human resources in the case of professors and researches, organizational resources in the case of companies that use COPPETEC as a partner in the management of R&D projects and technology resources developed in joint R&D projects. The public and private institutional boundaries overlap in this process, the management of these sharing resources is an important capability in the current stage of the organizational transformation that COPPE is facing towards an entrepreneurial orientation. Resuming, we could identify five entrepreneurial capabilities that were developed by COPPE/UFRJ: (i) managing university interfaces with external actors; (ii) integrating public policy initiatives; (iii) supporting entrepreneurial activities; (iv) technology transferring; (v) managing of sharing resources. Table 1 presents a brief description of each capability.

Table 1 – Entrepreneurial capabilities

Capabilities	Description
Managing university interfaces with external actors	Capability to manage projects that involve multiple actors from academia, government and enterprise sectors. Typical projects are R&D, consulting and infra-structure expansion / maintenance.
Integrating public policy initiatives	Brazilian institutional context for S,T&I involves a constellation of actors from federal, state and municipal government. In addition there are some non governmental organizations like Sebrae and Senai. Typical example of integrating public policies initiatives is the process of setting up of the business incubator, the technology transfer office and the technology park.
Supporting entrepreneurial activities	The support for entrepreneurial activities includes the facilities of the business incubator and the consulting services provided to the start-ups during the incubation period.
Technology transferring	The promotion of technology transfer involves two main activities (i) the identification and protection of marketable research; (ii) identification of potential deals in technology licensing. The technology transfer office concentrates the activities related to this capability.
Managing sharing resources	With the beginning of the technology park, R&D labs from big companies and technology based start-ups are located inside the campus of UFRJ. These companies share resources with the university. Common examples are sharing of infrastructure and human resources such as professor and researches.

In our analysis we could identify that the development of these five capabilities was carried on in tandem with the organizational transformation process. The development of each capability was associated with an organizational transformation faced by COPPE/UFRJ. Table 2 presents a resume of each capability developed and the organizational transformation associated.

Table 2 – Entrepreneurial capabilities x organizational transformations

Capabilities	Organizational transformation
Managing university interfaces with external actors	Creation of COPPETEC (1970;1993)
Integrating public policy initiatives	Creation of COPPETEC (1970;1993)
Supporting entrepreneurial activities	Creation of the business incubator (1994)
Technology transferring	Creation of the technology transfer office (2001; 2004; 2007)
Managing sharing resources	Creation of the technology park (1997; 2003; 2008)

These capabilities have been developed in different levels of maturity; managing university interfaces and the integrating public policy initiatives form the basic level of maturity. Without these two basic capabilities it is not possible to move for the intermediary ones; supporting entrepreneurship and technology transferring. These capabilities developed in the intermediary level of maturity form the basis for the advanced level; managing sharing resources.

The figure 1 illustrates the tree levels of maturity in the development of entrepreneurial capabilities at COPPE/UFRJ.

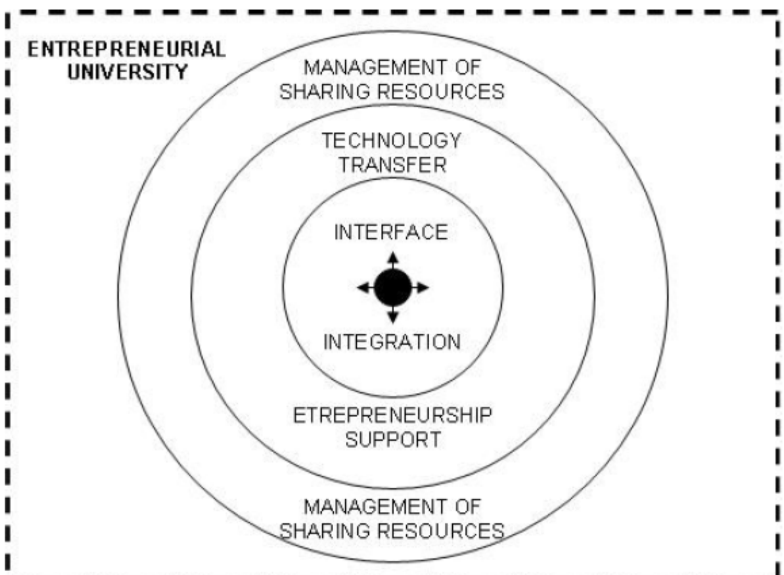

Figure 1. Different levels of maturity in the development of entrepreneurial capabilities

The key findings of our research are (i) the five entrepreneurial capabilities that were identified at COPPE/UFRJ; (ii) the existence of a connection between the organizational transformations faced by this academic unity and the development of entrepreneurial capabilities; (iii) the existence of different maturity levels in the development of entrepreneurial capabilities. These three key findings will be presented in detail in the next section.

4. Summary and conclusion

The analysis of the case of the Coordination of Engineering Graduation Programs (COPPE) from the Federal University of Rio de Janeiro (UFRJ) gives us important insights about the trajectory of universities towards an entrepreneurial role. COPPE/UFRJ is considered a successful case of entrepreneurial orientation in the Brazilian context, accumulating a trajectory of 49 years performing research activity in tandem with market needs. In this sense, our research is performed in a particular context where the research activity is well consolidated and there is a historical link with the market needs.

Our study attempted to answer the following questions: What are the main organizational transformations faced by COPPE/UFRJ in order to perform an entrepreneurial role? What are the key capabilities required for this performance? How these capabilities were developed?
We could identify that the main organizational transformations faced by COPPE/UFRJ were the establishment of COPPETEC, the creation of the business incubator, of the technology park and the technology transfer office. According to our analysis each organizational transformation is associated with the development of entrepreneurial capabilities. The establishment of COPPETEC leads to the development of two capabilities: managing university interfaces with external actors and integrating public policy initiatives. These capabilities form the basic level of maturity of the university towards its entrepreneurial role.
Upon the basic level of maturity, an intermediary one emerges associated with the creation and consolidation of the business incubator and the technology transfer office. In the intermediary level of maturity the capabilities of supporting entrepreneurial activities and technology transferring are integrated in the routine of the university. In the last years, a third level of maturity emerges with the consolidation of the science park and the overlap of the university resources and the ones connected with the private R&D laboratories located inside the campus. The capability of managing sharing resources emerges as a key one in the current stage of COPPE/UFRJ towards its entrepreneurial role. There are two different dimensions of the transformation process faced by COPPE/UFRJ: the organizational transformation and the development of entrepreneurial capabilities. We could identify an interactive evolution of both dimensions.

References

Anprotec, (2012) "Associação Nacional de Entidades Promotoras de Empreendimentos Inovadores – Panorama". http://www.anprotec.org.br
Capes (2012) "Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Cursos Recomendados". http://www.capes.gov.br/cursos-recomendados
CGEE (2010) "Demografia dos doutores no Brasil". http://www.cgee.org.br/
Clark, B.R. (1998) "Creating Entrepreneurial Universities. Organisational pathways of transformation" Pergamon IAU Press.
Coppetec (2012) "Relatório de atividades 2008". http://www.coppetec.coppe.ufrj.br/
Etzkowitz, H. (2002). "MIT and the Rise of Entrepreneurial Science". Routledge, London and New York.
Etzkowitz, H., Mello, J. M. C., Almeida, M., 2005, Towards meta innovation in Brazil: The evolution of the incubator and the emergence of a triple helix. Research Policy, v. 34, n. 4, p. 411-424.
Fortec (2012) "Forum Nacional de Gestores de Inovação e Transferência de Tecnologia". http://www.fortec-br.org/
Jacob, M., Lundqvist M., Hellsmark, H. (2003) "Entrepreneurial transformations in the Swedish University system: the case of Chalmers University of Technology" Research Policy 32 p. 1555–1568
Lahorgue, M.; Santos, M.; Mello, J. Economic Development Mission in Brazilian Universities. Conferência Triple Helix 2005, Turin, Itália, maio 2005. MCT 2011 "Indicadores Nacionais de Ciência e Tecnologia". http://www.mct.gov.br/index.php/content/view/740.html?execview .
Moray, N., Clarysse, B., (2005). "Institutional change and resource endowments to science-based entrepreneurial firms". Research Policy 34 p. 1010–1027.
Rasmussen, E., Borch O.J. (2010) "University capabilities in facilitating entrepreneurship: A longitudinal study of spin-off ventures at mid-range universities". Research Policy 39 p. 602–612.
Shane, S., Stuart, T. (2002). "Organizational endowments and the performance of university start-ups". Management Science 48 (1), 154–170.
Shane, S. (2004) "Academic Entrepreneurship: University spin-offs and wealth creation". Cheltenhan U.K. UFRJ (2009) "A UFRJ em Números" http://www.ufrj.br/
Vohora, A., Wright, M., Lockett, A., (2004). "Critical junctures in the growth in university high-tech spinout companies". Research Policy 33, 147–175.
Wright, M. et al (2008). "Academic Entrepreneurship in Europe". Edward Elgar Publishing Limited, UK.
Yin, R.K., (1989). Case Study Research. Design and Methods, vol. 5. SAGE Publications Ltd, Newbury Park.
Zahra, S.A., Sapienza, H.J., Davidsson, P., (2006). Entrepreneurship and dynamic capabilities: a review, model and research agenda. Journal of Management Studies 43 (4), 917–955.

FROM "FAMILY BASED" TO "INDUSTRIAL BASED" PRODUCTION COMBINING THE TRIPLE HELIX MODEL AND "EMPOWERMENT" IN A LED APPROACH.

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Abstracts
Many regions in the world are not yet developed in such a way that all the inhabitants of that region can live a life that at least meets some minimum standards of staying alive. Many attempts have been initiated and many theories have also been developed on how to set up economic activities. However, most of them were not working properly or were much too focused on the economic development at the macro level and did not realize that much improvement for the local communities. In this situation, the worldbank initiated a focus on local economic development programs, the purpose being to build up the economic capacity of a local area to improve its economic future and the quality of life for all. All kind of actors in a specific region has to become partners order to work together collectively to achieve goals. Here the triple helix idea comes in and we shall show that in the daily practice, as far as we have seen, the first initiatives for LED programs usually came from the national government and in a second phase were worked out by local actors. In terms of the Helix model this means for this kind of work that the government as an actor should be worked out in at least the national government and the local governmental agencies. Also for the business as an actor in the Helix model we will show in this paper that this kind of actor can also be more specified. In a second line of reasoning we will focus on how the actors can become partners and work together. For this we will borrow from the sociological field of knowledge. Concepts like "social capital", "empowerment" and "social entrepreurship" will be used to develop a theoretical perspective that might shed new light on what local economic development processes look like and how they can be influenced. From the perspective of the Helix model we pay attention to the questions of wich actors (or actor) take the initiative and what kind of activities are they starting with.
In cooperation with the Indonesian Government (The ministry of planning; the Bappenas), The Neso (Netherland Educational Office) we (The ITB and Rug) were invited to develop with them how to set up programs in a practical way for remote areas in such a way that local economic development could be initiated and worked out in (small scale) business activities with the extra condition that all or at least a large part of that local community was involved and the quality of llife of all people in these areas would improve.
Our REDS (we changed the name into Reds instead of Led) program focuses on resource development and empowerment of the local community. The basic idea underlying this program is that the growth of a region is dependent on its ability to come along with the competition in the market. Many regions in Indonesia possess products with a certain economic potential for national and international markets. Most of the time, these products and the way these products are produced are family based, dependent on the season, harvest conditions and availability of human power to produce. In our program, we strive to support activities that will present the possibility to change these family based production ways to a more industrialized way of producing these goods. Creating sustainable growth in the target regions by providing the government and policy makers with the knowledge and skills for developing more efficient and effective policies and strategies can be seen as the overall goal of the REDS program.

Keywords: Triple Helix model, Local Economic Development, Empowerment

Introduction
To build a strong local economy, good practice tells us that each community should undertake a collaborative, strategically planned process to understand and then act upon its own strengths, weaknesses, opportunities and threats. From this perspective we start with the local communities but how is this related to the perspective from the Helix model in which three actors are explicitly introduced: the Government, the Industry and the Universities? The purpose of local economic development (LED) is to build up the economic capacity of a local area to improve its economic future and the quality of life for all. To support the Local Economic Development in remote areas, a program has been developed based on the LED frame work of the world bank. This approach and the experiences over the past years with this program will be described in the first part. In the second part of the paper, we will describe our experiences with the help of some theoretical concepts: Social Entrepreneurship, Empowerment, Civil

Society/Citizenship and Social Capital and the Helix model We hope to discuss some possible improvements of our approach, open up new theoretical questions on the process of Local Economic Development and last but not least open up a way of fine tuning the general Helix model for the local situation.

Local Economic Development, the focus on the local actors and the Helix model.

Many regions in the world are not yet developed in such a way that all the inhabitants of that region can live a life that at least meets some minimum standards of staying alive. Many attempts have been initiated and many theories have also been developed on how to set up economic activities. However, most of them were not working properly or were much too focused on the economic development at the macro level. In this situation, the worldbank initiated a focus on local economic development programs, the purpose being to build up the economic capacity of a local area to improve its economic future and the quality of life for all. Thus, LED programs are all programs that are designed to improve the economic future of a specific region. Partners from different sectors in a specific region work together collectively to achieve goals, although, as we shall see in the daily practice, the first initiatives for LED programs usually came from the national government and, in a second phase, were worked out by local actors. In terms of the Helix model, this means that, for this kind of work, the Government as an actor should be seen as an actor acting on the national level and acting on the local level: the local governmental agencies. Also for the Industry as an actor in the Helix model, we will show in this paper that this actor can be more specified.

In all of these programs, however, the focus was on the local actors but not on how these actor activities could be studied with concepts from the more sociological perspective. Concepts like "social capital" and "social entrepreneurship" were not in the center of these programs and also not used in the beginning as a theoretical perspective that might shed new light on what local economic development processes look like and how they can be influenced. From the perspective of the Helix model, we pay attention to the questions of which actors (or actor) take the initiative and what kind of activities they are beginning with. This will also result in a more specified model of the Helix idea.

In this paper, we will use our own observations of field visits and our evaluation reports to begin conducting research with these concepts in relation with our work on supporting local economic development in several projects in Indonesia.

In cooperation with the Indonesian Government (The ministry of planning; the Bappenas), we (The ITB and Rug) were invited to develop with them programs in a practical way for remote areas in such a way that local economic development could be initiated and worked out in (small scale) business activities. An the extra condition was that all or at least a large part of that local community was involved, and the quality of life of all people in these areas would improve.

We made use of the work of Worldbank and of Swinburn to rely on a good definition of LED. According to Swinburn (2006), "The purpose of LED is to build up the economic capacity of a local area to improve its economic future and the quality of life for all. It is a process by which public, business and non-governmental sector partners work collectively to create better conditions for economic growth and employment generation." This definition is also used by the Worldbank on their website to define LED. Canzanelli (2001: 9) stresses that LED as a process in which local actors shape and share the future of their territory will stimulate and facilitate partnership between local stakeholders.

Our approach to support LED: REDS Programs

Our REDS program focuses on resource development and empowerment of the local community. The basic underlying idea behind this program is that the growth of a region is dependent on its ability to enter and to take part of the competition in the market. Many regions in Indonesia possess products with a certain economic potential for national and international markets. Most of the time, these products and the way these products are produced are family based and dependent on the season, harvest conditions and availability of human power to produce. In our program, we strive to support activities that will present the possibility to change these family based production ways to a more industrialized way of producing these goods. In order to accomplish this, many improvements and the right decisions need be made in order to improve. Improved quality, correct technical knowledge and the use of proper procedures to develop these products could provide an export potential for these products, leading to extra money flowing into the region. Creating sustainable growth in the target regions by providing the government and policy makers with the knowledge and skills for developing more efficient and effective policies and strategies can be seen as the overall goal of the REDS program.

In order to provide the government and policy makers with the right skills and knowledge needed for the development of strategies and policies, an education program has been developed at the University of Groningen

(UoG) in The Netherlands, the Neso in Jakarta, and the Bandung Institute of Technology (ITB) based on practical and successful experiences in Indonesia for approximately seven years.
In general, the education program concerns three teams from three different areas from all over the country. A multi disciplinary team consists of one representative from the local university, at least one representative from the entrepreneurial sector and a group of local officers from the province/ city/ area.
The REDS teams are responsible for 'one region and one product'. A target region in Indonesia and a product with a certain potential for national and international markets, produced in that region, are chosen. The implementation of the project in the region and the distribution of knowledge, the creation of networks, the involvement of people and the development of the products with economic potential are the responsibility of the REDS teams.
The national planning authority was basically responsible for the selection of the different participants on the basis of diverse selection criteria. Following the selection, a region was chosen which produced promising products, one of which needed to be selected. After choosing one region and one product, the REDS teams needed to be composed. The teams prepared a research proposal concerning the selected promising products, focusing on the potential for external demand and continued future growth, as well as the potential to raise incomes, create productive employment opportunities for the poorer households, and the possibility to increase initial earnings from export.
With the main goal in mind of creating sustainable growth within the target regions, training on the concept of local economic development is given as input to the REDS teams in Indonesia and in Groningen in the Netherlands. The training program plays an important role in the REDS program and is designed in the direction of offering experience through management exposure in the Netherlands which the teams can then apply to their own situation in order to deliver a contribution to the development of the economy. The training period will supply the REDS teams with essential information, knowledge, and skills for the implementation of action plans in the target regions. The Reds team must function as a driving force that will contribute to the development in the region as indicated in figure 1.

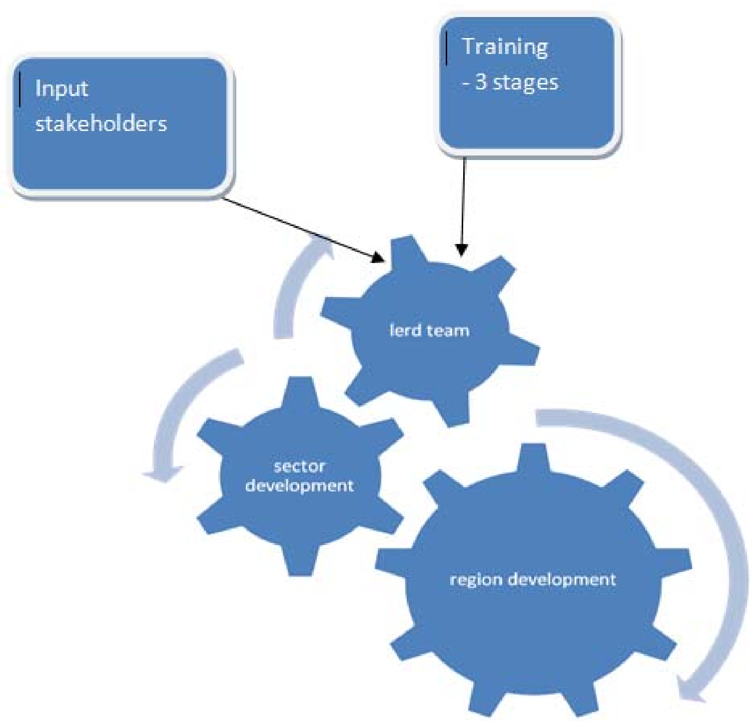

Figure 1: REDS team as the starting engine of the project

The training period begins with a training of five weeks with the first half of that period being spent in the country of origin but outside the living context of the teams that have been chosen. The second half of the time is spent in the Netherlands at the UoG After receiving information concerning the background of REDS and theories and practices of ways of planning, the teams can be engaged in the preparation of the first action plan. Following this training period, the REDS teams travel to the Netherlands. In Groningen, lectures are presented at the Faculty of

Management and Organization concerning diverse aspects like action planning, Quality Management, the SWOT analysis, the relationship between government and entrepreneurship, innovation and knowledge transfer.

Along with the lectures, field trips are made with the REDS group. In the Netherlands, the focus of the training is mainly on the development of a realizable action plan for each region to overcome the most institutional barriers for Local Economic Development. In the training of the concept of LED, the most essential parts and the analytical tools to analyze the institutional environment for LED are discussed. The training emphasizes the institutional setting, functions and skills for the attraction of direct investment, the development of products and technology, marketing and export and the development of small enterprises. Following the training period in the Netherlands, another period of training on the local universities in Indonesia is organized. In this period, further development of the action plans take place. The focus here is placed on customization of the regions for which the action plans are developed.

The action plans deal with different stakeholders which play an important role in obtaining the formulated objectives by the REDS teams. Stakeholders are needed to strengthen the people, the products and the industry as well as for the creation of networks. The group of stakeholders exists of research groups, farmers, quality control companies, entrepreneurs, technical support organization, universities, credit organizations, foreign investors, traders, exporters, the local and national government, and market research organizations. Access to the correct information with the proper level of detail and at the correct time is the key to effective stakeholder involvement. In the REDS program, the REDS teams are responsible for the participation of the right stakeholders at the right moment. In the regional seminar, scheduled 3 months from the beginning of the project and the national seminar, which takes place after one year, all stakeholders are invited to listen to the action plans of the REDS teams and have the possibility to interact with the team members and give them comments and ask questions. The seminars, organized in the country of origin, are important in order to update the stakeholders concerning the progress of the projects with the goal to draw new stakeholders and to spread the action plans among the different stakeholders and local inhabitants. Concurrently, the presentation of the action plans builds trust in the stakeholders due to the demonstration of the REDS teams' abilities to proceed independently in the program.

Theoretical perspectives on supporting Local Economic Development

Focus on the relations between the people involved: social capital

In our program, we spend a significant amount of time on the people who are involved. We begin with the three multi-disciplinary teams, but we also attempt to reach the stakeholders through the team members. We believe that, based on practical experiences, one of the crucial factors will be in which way and who is involved in starting up business wise production of activities. In the theories on development of human societies, we will make use of the concept of Social Capital. Social capital (thanks to Bob Jan Schoot Uiterkamp for this part on formulating this part of social capital, based on his master thesis (August, 2011) is commonly defined as (Woolcock (1998): "*The information, trust, and norms of reciprocity inherent in one's social networks"*. Coleman (1990) clarifies the distinction between human- and social capital. According to Coleman (1990), human capital consists of individual resources such as knowledge and skills while social capital exists in the relationship between social actors. Accordingly, social capital forms the basis for the accumulation of human capital (Westlund and Bolton, 2003) Thus, social capital is an attribute that is created in interactions among people, which increases the strength and value of personal qualities such as intelligence and work experience and is manifested in norms and networks that enable people to act collectively (Coleman, 1988). Socially excluded-, marginalized-, or systematically discriminated individuals, households or groups that partake in social networks can rely on the support of networks. Networks can bring benefits in terms of the provision of informal credit. In the areas in which REDS programs have been carried out, it will be interesting to see from this perspective how the social capital factor is developing. Creating a REDS team is already the beginning of networking, and the attempts to include more local stakeholders is also developing the networks in remote areas.

When looking at the time frame in which new programs will be initiated, it is relevant to investigate the social capital factor or, in business terminology: the institutional level of a region and, afterwards, in a time perspective, how the development will be on that level and how that might contribute to better economic development of that specific region.

Focus on who is taken the initiative: The Helix partners and social entrepreneurship

Birkholzer (2005) has already raised the question regarding who is taking the initiative by describing four scenario's: "The first scenario is called "development from above": The main actor here is the state, working top-down from the central government to regional government and local authorities. In this scenario, the local actors, people, and enterprises, as well as authorities, wait for decisions and resources coming from above sources because they believe that the state is either mainly responsible for all kinds of development or are the only source that has the power to do so. The second scenario is called “development from outside”: Outside investors are needed to bring in the necessary resources, especially money. It often follows the breakdown of the first option.What they have in common is that the local actors believe they cannot accomplish anything on their own. The third scenario could be called “wait and see”: The local actors remain more or less passive, waiting for things to come. Some might look at it as a quasi natural process of selection, and some may have resigned as a result of the failures of options one and two. The traditional “solution” in this scenario is migration. In fact, this is the most popular option, although it becomes more and more difficult to find places to go, not only because of political restrictions, but also for economic reasons. The islands of prosperity around the world become smaller in size and numbers.

The final scenario is called “development from within”: As option number one is dominated by the national goverment, number two by private investment and number three by fatalism, in this last scenario the local actors, the people themselves, play the key role. This is the heart of Local Economic Development: It begins when people realize that neither the state nor the market economy serve their needs or solve their problems and when they are unwillingly or unable to leave their homes. In terms of the Helix model, this is a change in actors from the national government to the local governmental agents and a change from bigger companies working also at the national level to smaller companies who focus on the local situations. And the last partner, the universities, will be the local universities in the region.

Within this last scenario, however, new questions must be raised. In practical situations, there will be questions such as who is going to take the initiative and or who is going to work out the initiative. In the answer, we have to consider that it will not only be individuals or one actor that will and can do this. In most cases, it will be combination of actors. Actors can be individuals, but much more often will be organizations like a cooperation, a department of a local governmental or non-governmental organization.

From a theoretical point of view, we can think of this also as a question of social entrepreneurship. “Social” refers, in this case, not just to the output of the activities or results that might be in benefit of the local community but also refers to the actors who work together as a group and develop group entrepreneurial activities. Within this perspective, we must broaden our questions and not just limit ourselves to who is taking the initiative but also in which way and with what kind of activities the initiative is developed and worked out.

Social entrepreneurs are assumed to include both public and private sector stakeholders as well as policy makers. Furthermore, social entrepreneurs can be seen not just as charismatic leaders and social revolutionaries but also as cornerstone movements, departments of governmental organizations, local corporations, labor unions, etc. or combinations of these local actors. In general, social entrepreneurs are the upsetting agents of the social sector: mission-driven opportunity seekers who are always searching for innovative solutions to social problems but, in the context of Local Economic Development, the focus is not just on the social problem of the incomes that are too low but also in setting up business activities. The social entrepreneur and the conventional entrepreneurs have much in common in this way. They both wish to set up economic activities to earn money, and they both want to create a business that is attractive to do (assuming that entrepreneurship is more than just trying to make as much money as possible). The first key difference, however, lies in the outline of the entrepreneurial objective with the social entrepreneur focusing on financial outputs *and on* social outcomes with equal value instead of the financial outputs as the most important one for the entrepreneur. The second key difference in this context is that the entrepreneurial activities are done or started by a combination of local actors and not just by one so called “entrepreneur”.

The scene of social entrepreneurship can be formulated as a continuum with not-for-profit voluntary activism on the one end and corporate social innovation at the other (Kanter, 1999: see Figure 2). On the left site it starts with a range of not-for-profit organizations that are socially driven: these range from fully funding to those that are partially self-sufficient having developed some internal sources of income. Next are social enterprises that are fully self-sufficient or moving towards self-sufficiency either through exploiting profit opportunities in their core business or through developing distinct activities through which the social mission may be funded. Finally, there are corporate divisions or discrete projects within conventional companies that aim at a social objective.

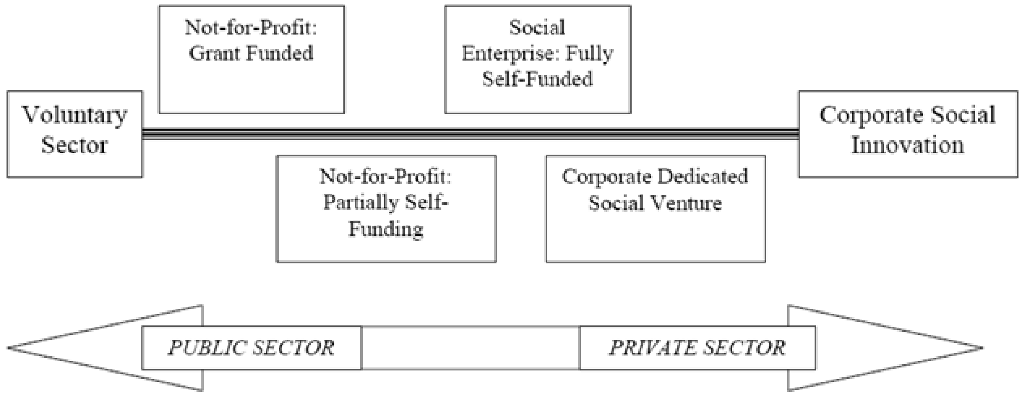

Figure 2. Funding dimensions of social entrepreneurship, Kanter, 199

In our projects, these means we must pay attention to the possible combinations of actors who are taking the role of entrepreneur, how they (the social entrepreneurs) are related and in which way the local society is interrelated.

Who is taking the initiative in the local situation: empirical observations.

Bau Bau (2007)

In Bau Bau the Reds team consists of five people. Seaweed was chosen as the main product to focus on. In this project, it became clear that the head of one of the departments of the local governmental agency took the initiative and worked out the work plans developed during the program. He was also the team leader but was able to further develop his role. He was highly supported by the team member of the local university, and the other team members were willing to work in this way. All of them realized that this was in favour of the things they wanted to realize as formulated in the business and action plans they developed.

Belitung (2008)

The Reds team from Belitung consisted of five people. The product they chose to stimulate the local economic development of their region was Fish Abon, a product that is made of fish by dry cooking the fish and adding all sorts of herbs so that the final fish abon can be used as added flavour to meals.

In this project, the civil servants of the local government took the initiative and attempted to involve the women of the fisherman. This project was on a very small scale. We visited a group of five women who worked together to stimulate the increase of production and improve the way the fish abon was produced. The women shared their knowledge and means and produced their product together. They formed a cooperation (or corporation) together, and this was supported by the civil servants of the local government.

Pekalongan (2008)

The Reds team from Pekalongan consisted of 7 people. The product they chose to stimulate their region's development was batik. On the one hand, in this region, there are some large families/companies and a lot of small families who all produce batik. The large companies produce the batiks by printing the textile with machines and the small families are making use of the handmade process of colouring the textile In this group, there was a remarkable young entrepreneur, a real businessman who truly wanted to improve the production process. Together with civil servants, he attempted to improve the way the batik was coloured because this process is very environmentally unfriendly. In this combination, they were also able to organize support from the major (the bupati) of Pekalongan. Along with this support, they also attempted to organize the small families in clusters so that they could learn from each other and support each other.

Pinrang (2008)

The Reds team from Pinrang consisted of 7 people. The product they chose to stimulate their region's development was shrimp. Following their return to Pinrang and during the local seminar, it became very clear that one of the shrimp farmers was the sole driver for development. He was a moderately wealthy fisherman and, during his stay in Groningen, he seemed to be less interested. Afterwards, the opposite became obvious (language was his biggest problem). It was also helpful that this fisherman, although he could have easily been the motor for economic development on his own, he also involved the civil servants of the local government to assist him and to help convince the other fisherman to also focus on what we labeled as " green shrimp".

Kendari (2009)

The Reds team consisted of 6 people, and they chose to stimulate the local economie by focusing on the fish abon. In Kendari, it was extremely difficult to determine who took the initiative and if there was any progress in their situation. It seems that the problems of producing fish abon in a more industrialized way are enormous (production, marketing, product diversification, etc.).

Singakawan (2009)

The Reds team consisted of 8 people, and they chose to stimulate their region by focusing on the production of corn. We noticed that the civil servants of the Bappeda (the local governmental planning department) were able to stimulate new activities. However, we also noticed two more actors. First, an older, impressive lady inspired the local farmers in improving their corn production and teaching them to diversify the crops. A second source of stimulation were the people from the local university (one was also a member of the team) who were helping individual farmers in improving the quality of the sweet corn (and it tasted amazingly good).

Tanah Datar (2009)

This team consisted of 8 people, and the product they chose was beef cattle. Due to the volcanic eruption in Iceland, we were not able to visit this group, therefore, we do not have field observations for our research.

Poso (2010)

The Reds team from Poso consisted of six people. The product they chose to stimulate the development of their region was cacao. In this group, we saw the driving force coming from one of the civil servants of the Bappeda. He had already been working in this area for a long time in this department, and almost all of the farmers knew and trusted him. With the help of the other team members, he was able to find a local NGO to help him convince the farmers about the plans of the team (and the local NGO was able to raise money from the Worldbank for this). In a second step, this team and the farmers were able to arrange an agreeable deal with a large company for selling their cacao nuts for a fair, transparent and fixed price and a clear indication system for the farmers on the quality of the beans they brought to the company. In this way, the problem of the wholesalers with their nontransparent price system was solved. This team was also able to do their work in a proper way with the support of the team member coming from the local university. Though not dominant, the team member was always present and always supportive for the group and for the outside world showing the importance of the work and the initiatives of this Reds team.

Banjarmasin (2010)

The Reds team from Banjar consisted of eight people. The product they chose to stimulate the development in their region was rubber. In Banjarmasin, the rubber farmers themselves where already organized in small cooperative groups. It looked like a type of impasse there because all the stakeholders knew about one of the main problems: the quality of the rubber that came from the farmers and was sold to the companies. In that relation, no one took the initiative to make possible improvement (A simple solution was available. The farmers would not add heavy material to the raw latex and then the company should pay a higher price for the raw latex). The cooperative groups had a strong internal bond but only a weak network existed over the groups, though developments toward a stronger network could be seen (more group meetings). There were also a number of richer farmers developing ways of adding value to the latex by drying and pressing the latex at the beginning of producing natural rubber.

Kupang (2010)

The Reds team from Kupang consisted of eight people. The product they chose to stimulate the development of their region was beef cattle. The team's initiative came through in their ability to organize the support from the local major (the Bupati) and the role of at least one of the team members. The farmer entrepreneur (a rich one) who was absorbing knowledge and experiences as much as he could during the program was working as an example for the other farmers to see how things could be done differently. The team was also able to organize the support from the Bupati due to one of the team members being his wife who was also successful in raising cattle (so a double role).

Conclusion

As Birkholzer (2005) is indicating in his fourth scenario, local economic development must come from within. The Helix model is stressing the Government, the Business and Universities as actors. We can see from our cases that this motor (and the Reds teams are the starting engines) from within might be different in each situation, but the public sector, and more specifically the local governmental agencies, still take part in that motor, only with newer roles compared to the earlier days. In our projects, it was the national governmental agency, the Bappenas, who initiated in cooperation with agencies from the level of the provence the first steps of Local Economic Development. But this could only be a start. The next steps have to be taken by local actors. And these local actors might reflect the same as in the Helix model: government, industry and university but at the local level!

At the local level, we have seen in our projects that, within this local Helix model, it was not always the same actor or combination of actors who took the initiative. Combinations of a head of a department with a local company or the Bupati himself, a head of department with a leader from the local cooperation, or a civil servant of a department with some farmers are all kinds of combinations we have seen. In terms of the Helix model, this means that the business as an actor at the local situation might be a local company but also a cooperation of fishermen or a group of woman.

As Helmsing in 2003 has already indicated, local economic development is about new roles for the public sector. This applies not only to central government but also to local governments. First, (local) government is to provide the right mix of local public goods and, secondly, must facilitate or *enable other actors, communities, private firms, workers* and NGOs to make their most productive contribution. In our cases, we have shown that indeed other actors beside the government are important. The most important thing we want to add is that, in most of our cases, it is clear that it will be a combination of actors that will function as a motor for local economic development. In these combinations, the local government was involved as an active partner in almost all of the cases, *but it was also clear that it was never the local government alone that took the initiative or continued the initiative*. In terms of the Helix model, all of the three actors are important. At the local level, it is not just the actors from the national level but also actors who work on the local level who are of importance for the local economic development initiatives. The attention must also be directed to all kinds of possibilities of cooperation between these local actors. Last, but not least, the actor Industry as an actor, from the Helix model encompasses at the local level much more than only private companies.

Refences:

Birkhölzer, K. 2005. *Local Economic Development and its Potential*. Paper for seminar of LED, Technet, Berlin.
The World Bank. 2009. http://go.worldbank.org/EA784ZB3F0. May 8.
Canzanelli, G. 2001. *Overview and learned lessons on Local Economic Development, Human Development, and Decent Work*. Working paper 1, ILO Programme "Universitas".
Coleman, J.S. (1990) in Coleman (ed.) Foundations of Social Theory. Cambridge, Harvard University Press.
Fenske, J. 2004. Fact sheet: Poverty in South Africa. *Human Sciences Research Council*. July.
Helmsing, A.H.J. 2003. Local economic development. New generations of actors, policies and instruments. *Public Administration and Development*, vol 23, no 1, 67-7
Kanter, R. (1999) *'From Spare Change to Real Change. The Social Sector as Beta Site for Business Innovation',* Harvard Business Review, May-June, pp.122-132
Pike. A, Rodríguez-Pose, Andrés and Tomaney, John (2007) 'What Kind of Local and Regional Development and for Whom?', *Regional Studies*, 41:9, 1253 – 1269
Robertson. J. (1985) "Local Work for Local People using Local Resources."
Swinburn, G., Goga, S., & Murphy, F. 2006. *Local Economic Development: A Primer Developing and Implementing Local Economic Development Strategies and Action Plans*. Washington, D.C.Light, P.C (2008) *The search for social entrepreneurship*, The Brookings institution, Washington
Putnam, R. D. (ed.) (2002) *Democracies in Flux: The Evolution of Social Capital in Contemporary Society*, New York: Oxford University Press.
Swinborn G., Goga S. & Murphy F. (2006) *Local Economic Development: A primer developing and implementing local economic development strategies and actions plans.* Worldbank.
Westlund, H. And Bolton, R. (2003) Local social capita land entrepreneurship. *Small Business Economics*, ovl 21 pp 77 -113
Woolcock, M. (1998) Social capita land economic development: Towards a theoritical synthesis and policy framework in Woolcock (ed.), Theory and Society 29, Amsterdam, Kluwer Academic Publishers, 1998)

ASSET ALLOCATION AND PERIODICALLY REBALANCING STRATEGY TO IMPROVE THE INVESTMENT RETURN PERFORMANCE: A STUDY OF THE PORTFOLIO RETURN USING INDONESIAN PANIN MUTUAL FUNDS FOR THE PERIOD OF 2005-2009

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Abstract
Asset Allocation Investment Strategy is a strategy that allocates investment among several different investment classes in certain proportions. Rebalancing Strategy aims to keeping the proportions of the investment back into the original proportions after sometime. By keeping the same proportion in these different investment class, investors are forced to apply "the buy low and sell high" principle. The principle of buying low and selling high is widely recognized but often difficult to apply in reality because of the involvement of emotional behavior.
The author forms three portfolios consisting of stock mutual fund, bond mutual fund and money market. Conservative Portfolio allocates 45 percent investment in Stock Mutual Fund, 35 percent in Bond Mutual Fund, and 20 percent in Money Market. Moderate Portfolio allocates 55 percent, 40 percent, 5 percent investment in Stock Mutual Fund, Bond Mutual Fund, and Money Market subsequently. Aggressive Portfolio similarly allocates 75 percent, 20 percent, and 5 percent. These proportions are kept in balance through rebalancing process. Three rebalancing process are applied, which is quarterly, semiannually, and annually. The return performance of all portfolios combined with these three rebalancing processes then will be compared each other and against the IHSG (Indonesian Stock Market Index) performance. Sharpe, Treynor, and Jensen risk adjusted return methods are used to compare these performances. This research used Indonesian Panin Mutual Funds Family which is: Panin Dana Maksima for Stock Mutual Fund, Panin Dana Utama for Bond Mutual Fund, and Money Market Fund. This research covers the investment period of 2005 – 2009.
The research result shows that Asset Allocation Strategy with Periodically Rebalancing gives better return compared to IHSG index performance. Aggressive Portfolio with quarterly rebalancing gives superior result compared to all other portfolios.

Keywords: Asset Allocation; Rebalancing; Investment Strategy

1. Background

Investors are constantly looking for superior investment strategy. The key for having a successful investment is very simple which is buying low and selling high. However, in reality because of the influence of market sentiment, individual psychology behavior, greediness, instead of doing buying low selling high activities investor is trapped into buying high selling low activities. Therefore it is mandatory for investor to have a good strategy in order to avoid trading based on market sentiment and other necessary factors.

For ordinary investors, it is almost impossible to always identify good assets and determine the proper time when to acquire it. Furthermore, ordinary investors usually do not have enough time and sophistication to enable successful investment. The majority of investors, regardless of their time horizon, are risk averse investors. Because of the many faces of stock market risk and the peculiarities of the market, even the long term investor are likely to behave as though they are short term traders. Most investors do not stay the course and consequently fail to earn respectable return on their investment. For short term or uncertain time frame risk averse investor which encompass the majority of investors, asset allocation model provide an ideal strategy (Mittra, Sahu, 2007). The asset allocation strategy can not only reduce portfolio risk to a level acceptable to the investors but also can achieve an increase of return. Asset allocation programs typically classified portfolio risk into three basic categories of investment portfolios that are unique because of their adherence to strict risk tolerance guidelines. These categories are popularly known as conservative, moderate and aggressive portfolios. Conservative Portfolio allocates 45 percent investment in Stock Mutual Fund, 35 percent in Bond Mutual Fund, and 20 percent in Money Market. Moderate

Portfolio allocates 55 percent, 40 percent, 5 percent investment in Stock Mutual Fund, Bond Mutual Fund, and Money Market subsequently. Aggressive Portfolio similarly allocates 75 percent, 20 percent, and 5 percent. These proportions are kept in balance through rebalancing process.

The occasional rebalancing will force investor to shift money form an assets that has performed well (sell high) into one that has lagged (buy low). For example, if stocks have been in a slump, an investor using a rebalancing approach would shift money from bonds and money market securities into stocks, taking advantage of the lower stock prices. By the same token, if this strategy is followed, after a period than of rising stock process, funds would be shifted from stocks to bonds or money markets.

In this paper, three rebalancing processes are being applied, which is quarterly, semiannually and annually. The return performance of all portfolios will be combined with three rebalancing processes to determine which method provides the best way of investing.

Problem Identification

There are three questions to be answered in this research as follows:

- Does asset allocation strategy give better risk adjusted return compared to that of IDX?
- Does rebalancing process in asset allocation strategy affect risk adjusted return of portfolio?
- Which does rebalancing process give the best risk adjusted return performance?

2. Theoretical Foundation

2.1 Asset Allocation

Asset allocation is an investment strategy that aims to balance risk and reward by apportioning a portfolio's assets according to an individual's goals, risk tolerance and investment horizon.

2.2 Rebalancing Process

Rebalancing is the process of selling portions of your portfolio that have increased significantly, and using those funds to purchase additional units of assets that have declined slightly or increased at a lesser rate.

2.3 Risk Tolerance Profile

One of the factors that should also beware by the investor is the risk tolerance profile of the portfolio. There are three basic categorized of portfolio risk profile which are conservative portfolio, moderate portfolio, and aggressive portfolio. These three categorized of portfolios are also could determine the types of investor based on their risk tolerance profile.

The author would take the Merril Lynch risk tolerance profile because Merril Lynch is already regarded as one of the world's premier providers of wealth management, trusted advisor, and superior execution.

2.4 Rate of return

In process of calculating risk adjusted return, the author also uses some source to get theoretical foundations. The rate of return on an investment in a mutual fund is measure as the increase or decrease in net asset value plus income distributions such as dividends or distributions of capital gains expressed as a fraction of net asset value at the beginning of investment period.

$$Return\ Portfolio = \frac{\Delta\ investment\ value}{Investment\ Value0}\ x\ 100\%$$

Where:

Investment $value_0$ = investment value at the beginning of period

2.5 Standard Deviation and Variance

Standard deviation is a measure of the dispersion of a set of data from its mean. In this research, standard deviation is used to measure the investment volatility and risk during the investment. The equation to calculate standard deviation will be listed below, as follows:

$$\sigma = \sqrt[2]{\frac{\sum (r-\overline{r})^2}{n}} \; ; \; \bar{r} = \frac{\sum_{i=1}^{n} r_i}{n}$$

Where: σ = standard deviation

x = monthly portfolio return

$\bar{x}$ = average portfolio return

n = total data

2.6 Covariance

Covariance is the measure of the degree how much two random variables of asset move in tandem. If two variables tend to move together is called positive covariance and if it is not move in line is called negative covariance.

2.7 Beta (β)

Beta is a measure of the volatility, or systematic risk, of a security or a portfolio in comparison to the market as a whole.

$$\beta = \frac{Cov\,(r_a, r_p)}{Var\ r_p}$$

Where:
ra = measures the rate of return of the portfolio
rp = measures the rate of return of the market
cov (ra,rp) is the covariance between the rates of return

2.8 Sharpe, Treynor, and Jensen Measurement

In order to find risk adjusted return and evaluate the performance of portfolio that, Sharpe's, Treynor's and Jensen's measure are needed to generate the risk adjusted return of the investment.
Sharpe's measure is dividing average portfolio excess return over the sample period by the standard deviation of returns over that period. Sharpe ratio measures the reward to (total) volatility trade off.
Treynor's measure gives excess return per unit of risk, but uses systematic risk instead of total risk, Jensen's measurement which is the average return on the portfolio over and above that predicted by CAPM, given the portfolio's beta and the average market return. Jensen's measure is the portfolio's alpha value.

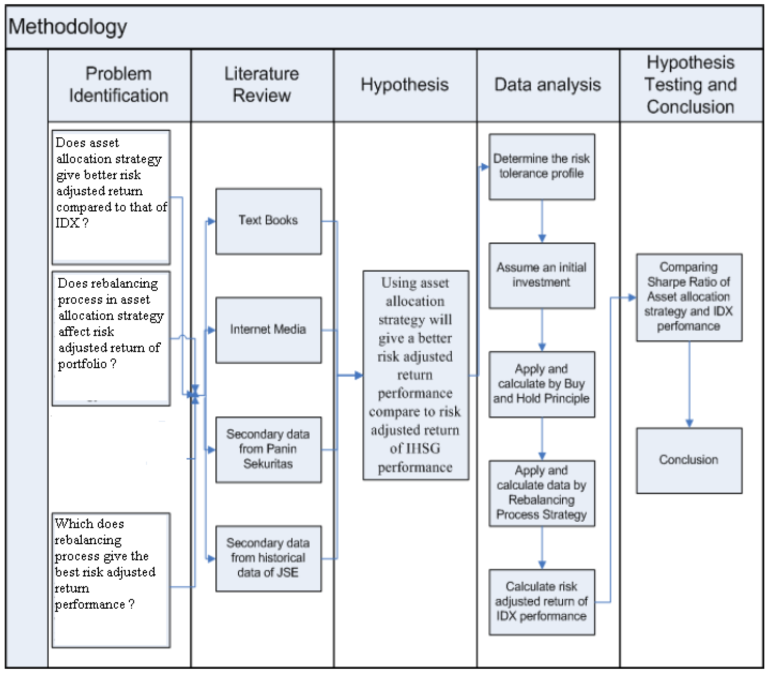
Sharpe : $S_i = \frac{\overline{R_i} - \overline{R_{fr}}}{\sigma_i}$

Treynor : $T_i = \frac{\overline{R_i} - \overline{R_{fr}}}{\beta_i}$

Jensen measurement : $\alpha = \overline{r_p} - \left(r_{fr} - \left(r_m - r_{fr}\right)\beta\right)$

Where:
r_p= return portfolio
r_m= return market
r_{fr} = risk free rate
β_p= beta portfolio
σ_p= standard deviation portfolio

3. Methodology



All data in this paper use secondary data from IDX data base and Panin Securities.

3.1 First Step: Determine the proportion of asset allocation strategy that would be applied

The composition of the asset allocation strategy that applied for this research that taken from Merril Lynch is, as follows:

Table 3.1 Risk of Tolerance Profile

Types of Investor	Proportions of asset allocation strategy		
	Panin Dana Maksima (Stock Mutual Fund)	Panin Dana Utama Plus 1 and 2 (Bond Mutual Fund)	Cash and Equivalent
Conservative	45%	35%	20%
Moderate	55%	40%	5%
Aggressive	75%	20%	5%

3.2 Second Step: Assume the initial capital to be invested

In order to simplify the calculation, the author makes the assumption of 100 million IDR to be invested as the initial value for each type of investor.

3.3 Third Step: Apply 'Rebalancing Process' strategy

The investment capital will be allocated in accordance with the risk profile portfolios (conservative, moderate, and aggressive). Rebalancing processes will be applied for quarterly, semiannually and annually. The risk adjusted returns resulted from rebalancing processes will be compared against each other.

3.4 Fourth Step: calculate risk and return profile of IDX in 2005-2009

In this step, the average monthly and yearly risk adjusted return for IDX performance will be calculated through Sharpe, Treynor, and Jensen ratio. Then, the risk adjusted return using Sharpe, Treynor, and Jensen Ratio of IDX will be compared to buy-and-hold strategy and then compared to the overall strategy.

4. Analysis

4.1 All portfolios performance comparison with all methods of rebalancing.

The summary of calculation result is presented in table 4.1.a. In this table, the return three portfolios are calculated based on monthly return and rebalanced quarterly, semi annually, and annually. Sharpe, Treynor, and Jensen measurement are being used to compare risk adjusted return.

Table 4.1.a Comparison of Risk Adjusted Return Using Quarter, Semi annual and Annual Rebalancing Process (Monthly Basis)

Quarter Rebalancing	Conservative		Moderate		Aggressive	
	Average Monthly Return	σ (monthly)	Average Monthly Return	σ (monthly)	Average Monthly Return	σ (monthly)
	1.615%	3.612%	1.769%	4.294%	2.176%	5.047%
Beta Portfolio	0.3976		0.4724		0.5519	
Sharpe	0.2971		0.2858		0.3237	
Treynor Ratio	0.0270		0.0260		0.0296	
Jensen Ratio	0.526%		0.577%		0.875%	
Semiannual Rebalancing	Conservative		Moderate		Aggressive	
	Average Monthly Return	σ (monthly)	Average Monthly Return	σ (monthly)	Average Monthly Return	σ (monthly)
	1.638%	3.870%	1.823%	4.679%	2.071%	5.703%
Beta Portfolio	0.4305		0.5215		0.6385	
Sharpe	0.3035		0.2984		0.3030	
Treynor Ratio	0.0255		0.0246		0.0240	
Jensen Ratio	0.504%		0.564%		0.652%	
Annual Rebalancing	Conservative		Moderate		Aggressive	
	Average Monthly Return	σ (monthly)	Average Monthly Return	σ (monthly)	Average Monthly Return	σ (monthly)
	1.713%	3.923%	2.015%	4.805%	2.284%	5.855%
Beta Portfolio	0.3729		0.5377		0.6586	
Sharpe	0.2985		0.3066		0.2976	
Treynor Ratio	0.0268		0.0274		0.0265	
Jensen Ratio	0.571%		0.734%		0.836%	

From the table above, the best risk adjusted return is shown by aggressive portfolio and by quarter rebalancing simultaneously.

The summary of calculation result based on the annual return is presented in table 4.1.b. The same three portfolios and three rebalancing period are also used. Sharpe, Treynor, and Jensen measurement are being used to compare risk adjusted return.

Table 4.1.b Comparison of Risk Adjusted Return Using Quarter, Semiannual and Annual Rebalancing Process (Yearly Basis)

Quarter Rebalancing	Conservative		Moderate		Aggressive	
	Average Annual Return	σ (yearly)	Average Annual Return	σ (yearly)	Average Annual Return	σ (yearly)
	21.737%	22.360%	24.691%	27.506%	28.967%	34.457%
Beta Portfolio	0.3237		0.3983		0.5000	
Sharpe	0.6814		0.6613		0.6520	
Treynor Ratio	0.4707		0.4567		0.4493	
Jensen Ratio	7.127%		8.214%		9.940%	
Semiannual Rebalancing	Conservative		Moderate		Aggressive	
	Average Annual Return	σ (yearly)	Average Annual Return	σ (yearly)	Average Annual Return	σ (yearly)
	22.121%	24.497%	25.219%	30.084%	29.725%	37.760%
Beta Portfolio	0.3571		0.4391		0.5513	
Sharpe	0.6377		0.6222		0.6151	
Treynor Ratio	0.4374		0.4263		0.4213	
Jensen Ratio	6.674%		7.720%		9.416%	
Annual Rebalancing	Conservative		Moderate		Aggressive	
	Average Annual Return	σ (yearly)	Average Annual Return	σ (yearly)	Average Annual Return	σ (yearly)
	23.925%	26.204%	27.168%	31.928%	31.851%	39.774%
Beta Portfolio	0.3785		0.4623		0.5774	
Sharpe	0.6650		0.6473		0.6374	
Treynor Ratio	0.4604		0.4471		0.4390	
Jensen Ratio	7.943%		9.087%		10.886%	

From the table above, the best risk adjusted return is shown by conservative portfolio and quarter rebalancing simultaneously.

4.2 Performance comparison between all portfolios and IDX

The performance comparison between all portfolios and IDX is summarized in the table below:

Table 4.2.a. Comparison of Risk Adjusted Return Using Rebalancing Process and IDX Performance (Monthly Basis)

Monthly Basis Calculation						
Buy and Hold Strategy	Conservative		Moderate		Aggressive	
	Average Monthly Return	σ (monthly)	Average Monthly Return	σ (monthly)	Average Monthly Return	σ (monthly)
	1.68%	0.0488841	2.07%	0.05501225	2.42%	0.0664537
Beta Portfolio	0.5288		0.6206		0.7535	
Sharpe	0.2336		0.2779		0.2819	
Treynor Ratio	0.0215		0.0246		0.0248	
Jensen Ratio	0. 414%		0. 675%		0. 837%	
Rebalancing Process						
Quarter Rebalancing	Conservative		Moderate		Aggressive	
	Average Monthly Return	σ (monthly)	Average Monthly Return	σ (monthly)	Average Monthly Return	σ (monthly)
	1.615%	3.612%	1.769%	4.294%	2.176%	5.047%
Beta Portfolio	0.3976		0.4724		0.5519	
Sharpe	0.2971		0.2858		0.3237	
Treynor Ratio	0.0270		0.0260		0.0296	
Jensen Ratio	0.526%		0.577%		0.875%	
Semiannual Rebalancing	Conservative		Moderate		Aggressive	
	Average Monthly Return	σ (monthly)	Average Monthly Return	σ (monthly)	Average Monthly Return	σ (monthly)
	1.638%	3.870%	1.823%	4.679%	2.071%	5.703%
Beta Portfolio	0.4305		0.5215		0.6385	
Sharpe	0.3035		0.2984		0.3030	
Treynor Ratio	0.0255		0.0246		0.0240	
Jensen Ratio	0.504%		0.564%		0.652%	
Annual Rebalancing	Conservative		Moderate		Aggressive	
	Average Monthly Return	σ (monthly)	Average Monthly Return	σ (monthly)	Average Monthly Return	σ (monthly)
	1.713%	3.923%	2.015%	4.805%	2.284%	5.855%
Beta Portfolio	0.3729		0.5377		0.6586	
Sharpe	0.2985		0.3066		0.2976	
Treynor Ratio	0.0268		0.0274		0.0265	
Jensen Ratio	0.571%		0.734%		0.836%	
IDX Performance	Average Monthly Return	σ (monthly)				
	1.917%	7.924%				
Beta Portfolio	1					
Sharpe	0.1736					
Treynor Ratio	0.01376					

Table 4.2.b. Comparison of Risk Adjusted Return Using Rebalancing Process and IDX Performance (Yearly Basis)

Yearly Basis Calculation

Buy-and-Hold Strategy	Conservative		Moderate		Aggressive	
	Average Annual Return	σ (yearly)	Average Annual Return	σ (yearly)	Average Annual Return	σ (yearly)
	26.124%	31.685%	29.514%	37.733%	35.654%	47.575%
Beta Portfolio	0.4756		0.5612		0.7000	
Sharpe	0.6004		0.5995		0.6097	
Treynor Ratio	0.4056		0.4067		0.4159	
Jensen Ratio	7.378%		8.765%		11.575%	

Rebalancing Process

Quarter Rebalancing	Conservative		Moderate		Aggressive	
	Average Annual Return	σ (yearly)	Average Annual Return	σ (yearly)	Average Annual Return	σ (yearly)
	21.737%	22.360%	24.691%	27.506%	28.967%	34.457%
Beta Portfolio	0.3237		0.3983		0.5000	
Sharpe	0.6814		0.6613		0.6520	
Treynor Ratio	0.4707		0.4567		0.4493	
Jensen Ratio	7.127%		8.214%		9.940%	

Semiannual Rebalancing	Conservative		Moderate		Aggressive	
	Average Annual Return	σ (yearly)	Average Annual Return	σ (yearly)	Average Annual Return	σ (yearly)
	22.121%	24.497%	25.219%	30.084%	29.725%	37.760%
Beta Portfolio	0.3571		0.4391		0.5513	
Sharpe	0.6377		0.6222		0.6151	
Treynor Ratio	0.4374		0.4263		0.4213	
Jensen Ratio	6.674%		7.720%		9.416%	

Annual Rebalancing	Conservative		Moderate		Aggressive	
	Average Annual Return	σ (yearly)	Average Annual Return	σ (yearly)	Average Annual Return	σ (yearly)
	23.925%	26.204%	27.168%	31.928%	31.851%	39.774%
Beta Portfolio	0.3785		0.4623		0.5774	
Sharpe	0.6650		0.6473		0.6374	
Treynor Ratio	0.4604		0.4471		0.4390	
Jensen Ratio	7.943%		9.087%		10.886%	

IDX Performance	Average Annual Return	σ (yearly)
	0.315502059	0.5185659
Beta Portfolio	1	
Sharpe	0.483066987	
Treynor Ratio	0.250502059	

Based on the Table 4.2.a. and Table 4.2.b., all portfolios with rebalancing methods give the better risk adjusted return compare to IDX performance.

5. Conclusion

From the data analysis in the previous section we can conclude that asset allocation strategy gives better risk adjusted return compared with risk adjusted return of IDX. Rebalancing process in asset allocation strategy, affect the risk and return performance for all portfolios, from the three rebalancing processes we can conclude quarter rebalancing gives the best result among of portfolios. Further research can be done using other data sets because the result of this research uses only Panin Mutual Fund.

Since the transaction cost and taxes are ignored in this research calculation, so the further research should consider this kind of reduction in return performance.

References

[1] Bodie, Z., Kane, A., & Marcus, A. J., 2009, *Investment,* Eight Editions. New York: Mc. Graw-Hill Companies, Inc.

[2] Brown, K. C., & Reilly, F. K., 2009, *Analysis of Investments and Management of Portfolio*. South-Western, Cengage Learning.

[3] Gitman, Lawrence J. 2009. *Principles of Managerial Finance,* twelfth Edition. Pearson Education, Inc.

[4] John Y. Campbell, Luis M. Viceira., 2002. *Strategic Asset Allocation*. Oxford University Press Inc. New York.

[5] Lynch, Merrill, 2003, *Managing Your Wealth: A Primer on Asset Allocation and Portfolio Management*, Global Securities Research & Economic Group, Global Investment Strategy Department, 21 January, 1-17.

[6] Mittra, S., A. P. Sahu, R. A. Crane, 2007, *Practicing Financial Planning for Professional*, Rochester Hills Publishing Inc.

[7]Sharpe. William F., 1992, *Asset Allocation: Management Style and Performance Measurement*, The Journal of Portfolio Management, Vol. 18 No: 2 pp 7-19

[8] BI Rate retrieved from http://www.bi.go.id/

THE MODEL OF ENTREPRENEURIAL UNIVERSITY AS APPLIED TO RUSSIA: THE CASE OF TUSUR.

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Abstract
Disaster management is the dynamic form of series of integrated and sustainable activities that is carried out before, during and post disaster in order to realize the optimum protection to the community, social assets, economy and environment (Rachmat, 2004). National and local governments play a key role in it, especially in the disaster risk reduction by establishing the policies, plans and programs. Universities and research institutions supports the effort by providing expertise in the tools and methodology as well as providing education and training for the government's personals. Businesses, in form of private consultancies, get involved in the project level by processing and analyzing the data using the appropriate methods.
Strategic and environmental assessment is the keywords in Strategic Environmental Assessment (SEA). Strategic means that it happens in an early enough stage in the decision makingtional bodies in terms of exchange of hardware and software equipment with relevant data.
Padang city lies in hazard prone areas such as earthquake, landslide, volcanic eruption, flood and tsunami, derived from subduction zone in the sea and major faults in the onshore Sumatra. A recent disaster is an earthquake on 30th of September, 2009 with the magnitude of 7.6 Richter scale. Padang city suffered severe damage due to this earthquake that is followed by landslide. 253,490 houses and buildings are destroyed and 1,195 people died.

Keywords: Disaster Management, Strategic Environmental Assessment, Building Infrastructure

1. INTRODUCTION

In a dynamic knowledge-based economy, researchers draw attention to the model of an entrepreneurial university. To qualify to deal with globalization and internationalization challenges and to acquire competitive advantages, universities seek to implement new qualities and to begin to play a new role in addition to already existing traditional university roles. Russian reality operates with adopted notions, sometimes even not naturalized ones. This paper attempts to look at modern Russian universities in today's economic environment trying to aggregate common traits for building the model of an entrepreneurial university which could be transparent and applicable to Russia. First, the paper outlines the idea of an entrepreneurial university how it is seen in the Russian Federation and pointing out the contradiction with a generally accepted universal model. Second, basing on system analysis procedure and institutional analysis, the paper suggests a matrix with university institutional functions that possibly could be used for an entrepreneurial university model building.

For Russian reality it is still very difficult to identify what such a term as an entrepreneurial university means. Since there is no clear definition for the term, we will try to evaluate different approaches for evaluation of a Russian university from a standpoint of possessing characteristics of an entrepreneurial entity basing on the specific case of our university – Tomsk State University of Control Systems and Radioelectronics.

2. ENTREPRENEURIAL UNIVERSITY MODELS

2.1. Entrepreneurial University in the Triple Helix Model

Nowadays, the challenge imposed by global economy leaves no option to universities in their development paths. Any institution is striving to be competitive on global, national or regional market selling primarily its educational services. Researchers in their analysis of characteristics of the entrepreneurial university identify specific features of such an institute. For example, Henry Etzkowitz in the Triple Helix model determines the leading role of the university in the innovation process. Considering the dynamics of the university in stages, he formulates the principles of the entrepreneurial university: academic ability to define strategic goals and achieve them, monitoring the academic and financial resources, institutional capacity for technology transfer, and business ethics at the university (Etzkowitz, 2008).

According to this vision of an entrepreneurial university as an entity, we presume that though all these pillars are partially present at TUSUR, Russian reality seriously interferes with the autonomy of the university as a state institution in terms of control over its resources and formulation and implementation of a strategic vision. Besides, there are legislative gaps in the intellectual property domain and lack of time for evolutionary development of organizational capacity for technology transfer.

The model of the entrepreneurial university is opposed to the university in the ivory model - inward-looking and striving for a certain social isolation system. The entrepreneurial university is characterized by outward orientation, the desire for communication and interaction with society.

2.2. General Criteria Used for Entrepreneurial University Performance Evaluation

While reviewing the cases of well-known entrepreneurial universities in the world, it is obvious that specialists assess universities according to a number of criteria. These criteria are formulated empirically and represent a combination of some of the following characteristics:

- institutional environment (how the university provides an environment for effective student start-ups and businesses generated by the graduates);
- involvement of students (how students can express themselves as entrepreneurs in a university and environment around it);
- the staff of the university (how university staff is involved in the generation of businesses and business practices);
- the impact of university entrepreneurship (how a university affects the university community outside the university walls, including the regional innovation system) (*Times Higher Education's World University Ranking*, 2011).

In case studies, regional specifics have also to be taken into account. For example, for the universities in Singapore, a small island nation, the ability to attract foreign students and researchers is a very important additional criterion of the entrepreneurial university, as Singapore universities lack human resources. In the analysis of entrepreneurial universities in the U.S. we must consider all the factors that are already included in the "Carnegie Classification" (classification of universities according to their mission), which takes into account many characteristics, including the number of students and funding, etc.

3. DEVELOPING THE ENTREPRENEURIAL UNIVERISTY MODEL: THE CASE OF TUSUR

3.1. Russian Universities and Science: Background and Specifics

The active role of universities in the innovation process is very natural for Western society. Though for Russians, there is a certain ambiguity in the perception of tertiary education sector in Russia in terms of its goals and principles. The typical traditional mindset is highly influenced by specifics in science and research development in Russia, science financing mismatches, traditions of non-disclosure of R&D results. The R&D sector in the USSR was represented by their major science clusters: the Academy of Sciences with its infrastructure and own finance resources, applied science with its partnership with hi-tech industries, and universities with students as their main resources. Nowadays, Russian universities still experience pretty much the same research model as in Soviet time. Also, they need new organizational models since it is obvious that R&D university units are not capable of relying on federal government donations only.

It is necessary to mention the specifics of Russian reality when we talk about the triple helix model. Unlike many countries of the world where university is the place both for science and education, Russian universities account only 7% of expenses allocated to R&D. At the same time basic research is still conducted by institutes of Russian Academy of Sciences as it was during Soviet era. Only 45.4% of Russian universities are engaged into research activities and only 18.7% of university lecturers and professors work on research projects. Thus, Russian science still resembles very much to the Soviet science: 73% of the scientific and research organizations are still owned by the government and this ratio has hardly been changing during last 10 years (Dezhina, 2011). Thus, while building a structural-functional model of Russian national innovation system, we identify two separate elements as universities (education) and research institutes (science) (Monastyrniy, 2005). Such a separation accentuates relative weakness of university research.

3.2. TUSUR and its Environment

Created in 1962, TUSUR from its very beginning had a project-conscious approach as its basis. As a crucial cornerstone of TUSUR's entrepreneurship logic was the idea that scientific advisors and researchers responsible for particular R&D contracts were capable of managing all finances allocated to particular orders. Scientists and researchers bearing responsibility for fulfillment of R&D contracts gained at the same time authority and influence within the university. Soviet military demands resulted in the development of TUSUR's organizational culture which was not institutionalized but was widely accepted. Some steps towards the understanding and realization of entrepreneurship principles have been taken both according to world practices, and based purely on the intuition and experience of TUSUR's leaders.

TUSUR's innovation infrastructure is represented by its Commercialization Office, student business incubator, technology business incubator. Also, there are opportunities for a new company to be relocated to a special economic research and development zone of Tomsk Region. A close market environment or economic cluster also called "innovation belt" includes 125 companies operating in TUSUR's technology specialization area. Most of these companies were generated by TUSUR, started by TUSUR's employees and employ TUSUR's students and graduates. These companies manufacture considerable amount of high-tech products in Tomsk Region and they make part of the Educational, Scientific and Innovation Complex of TUSUR (UNIC) with the university in its core.

In 2010, the Russian government enacted a revolutionary Federal Law 217 widely known in Russia as FL-217. This law authorizes the creation of hybrid structures (new companies) within university in collaboration with industry. Nevertheless, implementation of this law confirms that two years performance of such hybrid structures created under this law is not enough, since the evaluation is commonly built on accounting the number of such companies and not on measuring their real economic efficiency.

UNIC's companies create R&D units within the university. It might be a research institute or scientific laboratory, a new start-up company (according FL-217) or educational department (chair) teaching students for the needs of the business. UNIC's companies can provide a primary market for TUSUR's new R&D results, but the network interaction of TUSUR and UNIC cluster business is relatively weak and requires further institutionalization.

The new educational organizational approach is represented by a project approach to R&D and is known as GPO model (group project educational process). Being conceived as small creative R&D groups (3-8 students) with individual approach of scientific advisors to every student, GPO studies embrace the university's third and fourth year students. Today TUSUR has around 250 GPO groups which later can become residents of the student business incubator and move further on within TUSUR's innovative infrastructure. This project approach teaches students to work as small businesses, but at the same time it is not efficient enough since it does not lead to the creation of a sufficient number of start-ups. During the USSR era the country lacked a market economy and educational establishments did not promote entrepreneurship as an important societal function (The New York Academy of Sciences, 2010). Today Russian technological school standards demonstrate failure in providing entrepreneurship courses to raise entrepreneurship literacy standards for students engaged in math, physics, applied science and engineering.

It is necessary to emphasize that TUSUR is one of five largest universities in Tomsk, where every fifth inhabitant is a student. Nevertheless, when we talk about general research performance the figures we get are not quite promising. There is a general understanding that governmental allocations into innovation infrastructure do not give sustainable results.

3.3. Russian Notion for Entrepreneurial University

Today, Russian tertiary education uses a very fashionable notion of an "entrepreneurial university", though there might be crucial misunderstanding of the notion in general. Very often the society substitutes the concept of the entrepreneurial university term by any kind of university activity that can be visualized (from teaching entrepreneurship to launching a business incubator which will not host businesses in the future). The question widely discussed right now is the question of the "research university" – the status of a university which brings substantial financial governmental resources to the university budget. At the same time, there is an ongoing discussion to what extent such a university can be entrepreneurial if it can be at all.

The concept of an entrepreneurial university provides us with a great amount of thoughts. The problem is that there is only a vision of such a university. Any universal model – if there is such in the domain of an entrepreneurial university studies – does not necessarily fit well any regional innovation environment and corresponds to specifics of a particular chosen university. For example, when we look at TUSUR from the standpoint of developed countries (USA, Western Europe) we identify a great difficulty in applying the models suitable for these countries to Russian reality.

Today's TUSUR activity also poses certain questions. For example, the group project approach more than any other educational techniques stimulates creative thinking since the real project simulates company's R&D activity. At the same time there is a gap in the development of management and marketing skills. This emphasizes

Russia's general problem of disconnection between Russian strength in science and the ability to turn that science into products and new companies providing the potential for rapid growth through implementation of commercialization processes (The New York Academy of Sciences, 2010).

Russia's academia inadvertently sees the "ivory tower" model as the most appropriate for today's stage of economic development. Such a vision resides in the Soviet past of Russia. So, to move on it is necessary to legitimize the model of an entrepreneurial university. This model does not contradict the idea of a research university – the image of a university that Russian science has been accustomed to for many decades. A serious problem for higher education arises from the weak internal market demand for innovation and poor knowledge of hi-tech international markets. There is a need for a shift in the traditional mindset making it clear that the Russian federal budget cannot provide enough financing for universities' competitive development. Today it is clear enough that there are legislative changes, and implementation of Federal Law 217 should provide a new legal environment for a dialogue of university and industry with government. Being launched in 2010, the Federal Law-217 previewed the formation of joint companies (1/3 owned by university, 2/3 own by business) for realization of the projects with intellectual property or research results generated by university. Nowadays, it is still very difficult to analyze the overall performance of such economic entities except for the entire number of entities themselves.

3.4. System Analysis Approach Towards the Model of Entrepreneurial University: Findings and Interpretations

Studies of the characteristics of the entrepreneurial university clearly demonstrate the presence of a university innovation function in addition to traditional educational and research functions. The increasing complexity of communications in the world, increasing requirements of society to the university as a key institution of cultural and social development, as well as pressure of the global economy force the university to respond to the needs of society.

System analysis can help us with the vision of the model of an entrepreneurial university and can help us to avoid some contradictions within Russian reality. While looking at the university as a system, we should analyze both internal and external environment of a system. In any innovation system (national and regional innovation systems) a university performs three institutional functions: education, research and innovation. Traditionally all these three functions were appearing in the process of university evolution developing each at once to cope with the external challenges that university was facing. Table 1 shows the matrix of institutional functions and the roles that a university plays in the socio-economic system.

Table 1 Matrix of university institutional functions

Society	**Economy**	**Institutional Functions**
Universal Culture Creation	Developing Human Resources	Education
Fundamental Research	Applied Research	Research
Business Environment Development	Business Generation	Innovation

Today, educational function of a university is realized through professional education and teaching. In society in general such a function deals with forming societal cultural level. Research function in economy and society is realized through applied and basic research. Finally, innovation function deals with business generation in economy and forming entrepreneurial environment in the society. For Russian reality all different types of universities can be easily characterized by correlation of these three functions as well as universities' missions to serve the society.

TUSUR in this matrix clearly has all three functions. It can even be described as entrepreneurial research university. Moreover, TUSUR is engaged in scientific research as much as any other university in the region. From the standpoint of entrepreneurial function, it turns to be the leading one in the region.

In order to identify TUSUR's innovation function, let's take a closer look at Educational, Scientific and Innovation Complex of TUSUR (UNIC) which is represented by more than 120 companies. Approximately half of these companies should be characterized as an innovation cluster with the university as the core. To evaluate the cluster performance in the regional innovation system, it is necessary to analyze the regional economic statistical data. According to regional statistics of 2010, the scope for evaluation included manufacturing sector and high-tech and innovation sector represented by 62 and 114 large-sized companies, medium and small enterprises respectively (Monastyrniy, 2012). In the manufacturing sector, small and micro companies' performance is rather invisible; the economic input is allocated to super large companies (54%) and large and medium-sized companies (44%). We can see a completely different situation in the high-tech and innovation sector where there are no super large companies. This fact is easily explained that in the regional statistics such companies are included in the manufacturing sector. But at the same time, economic input of small and micro companies goes up to 29%. Also, such business accounts 107 responding entities out of 117 companies engaged in the regional statistical survey. In the comparative analysis of small and medium enterprises (SMEs) in general in Tomsk Oblast and SMEs of TUSUR's UNIC, it becomes obvious that the innovation performance is rather higher in UNIC's SMEs. For example, the share of innovation products/services accounted 50.7% in Tomsk Regions' SMEs and 84.5% in TUSUR's UNIC SMEs. The ratio of knowledge-intensive products accounted 11.0% and 30.1% respectively. R&D expenses in SMEs are represented by 7.9% and 14.8% respectively. The figures for companies' overall economic performance in this statistical research are rather controversial, since the research took place in 2009-2010 when the entire world economy experienced the repercussions of world economic crisis. Nevertheless, some indicators are quite revealing of certain processes within the entrepreneurial university what allows us to discover the specifics of TUSUR and its environment. This was an example of generating business, or economic entities, by the university as well as business environment development through influence of TUSUR's performance in the regional innovation system.

Another example of the innovation function is the role of TUSUR in the direct innovation chain starting from idea generation to product manufacturing. This process includes different stages as idea generation, fundamental and applied research, pilot and mass production. This process can be seen through people engaged in the process and through infrastructure required to fulfill the goals. TUSUR has almost the entire infrastructure needed for business generation starting from education through student group project work. Since a number of these small research groups is rather considerable, it is possible to evaluate the overall performance of the student research work. The outcome of such a work is primarily educational, less team building and even less business idea generation. At the same time, TUSUR's innovation infrastructure supports those student projects resulting in business idea trying to promote successful projects even further.

4. CONCLUSION AND FURTHER RESEARCH

The notion of entrepreneurial university is rather vague even for many specialists in Russia. It is clear that a university striving to be entrepreneurial has to possess certain characteristics. Adopting a term as in the case with any adopted institution is risky and might lead to misunderstanding the entire process inherent to entrepreneurial university. Any country is unique, but the more different is economic situation and underlying conditions, the more difficult is to use a model basing on the criteria developed for completely different macro environment.

This paper has identified the gaps while using the models built originally for other countries. Basing on the institutional functions of the university, this work tried to characterize the specific innovation function of TUSUR. Further research will be devoted to developing the university institutional function matrix as well as measuring the potential of every area of the matrix to introduce the criteria in order to approbate the research results on other Russian universities.

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REFERENCES

Dezhina, I.G. (2011). The Nature of Russian "Triple Helix" Interrelations among Government, Science and Business. *Innovatsii*, Vol. 4, pp. 47-55 (in Russian).

Times Higher Education's World University Ranking.(2011). Entrepreneurial University of the Year 2010/2011. 2011. [Online resource], URL: http://www.ncee.org.uk/publication/entrepreneurial_university_of_the_year.pdf (Retrieved April 12, 2012).

Etzkowitz, H. (2008). The Triple Helix: University-Industry-Government. Innovation in Action. New York: Routledge. P.164.

Monastyrniy E.A. (2005). Structural Model of an Innovation System. *Innovatsii*, Vol.8, pp.49-54. (In Russian).

Monastyrniy E.A. (2012). Innovation Strategy of Tomsk Region and the Role of Companies of TUSUR's Innovation Cluster in the Realization of the Strategy. Proceedings of the International Conference "Modern Education", February 2-3, 2012, pp.109-111. (in Russian).

Pavlova I.A. (2012). The Entrepreneurial University Model. Proceedings of the International Conference "Modern Education", February 2-3, 2012, pp.97-98. (in Russian).

The New York Academy of Sciences. (2010). Yaroslavl Roadmap 10-15-20. August 20, 2010. [Online resource], URL: www.nyas.org/yaroslavlroadmap. (Retrieved on April 25, 2012).

ENTREPRENEURSHIP DEVELOPMENT: COLLABORATION AMONG EDUCATION, POLICY MAKERS, AND BUSINESS

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Abstract
The role of Entrepreneurship in economic growth, job and wealth creation have been acknowledged. There are several ways how entrepreneurship can affect economic growth. Porter (1990) grants entrepreneurship as a crucial role when considering economic growth from a national perspective. Entrepreneurship is a catalyst for economic growth and national competitiveness GEM Report (2010), and Schumpeter (1934) emphasized the role of entrepreneur as a prime cause of economic development. In mid-1990s, policy makers in many countries and international organizations beginning to explicitly recognize the importance of entrepreneurship and making general statements about their commitment to improve the entrepreneurial environment Lundström and Stevenson (2005), Hart (2003), OECD (2007). In Indonesia, entrepreneurship has developed rapidly, it was showed by the increasing number of school which offer entrepreneurship program. However, Hatta Rajasa (Menteri Koordinator Perekonomian) said that the amount of entrepreneurs in Indonesia is still small, it is about 0,18 percent of population, meanwhile according to David McClelland, the country will be prosperous if minimum number of entrepreneurs is 2 percent of the total population.
This paper will discuss several efforts collaborating among three parties include government as a policy maker, academician with research and knowledge in entrepreneurship, and from business actors point of views, in order to build a supporting environment and infrastructure to create entrepreneurs.
The methodology used in this paper is literature study of entrepreneurship curriculum in several schools, and a good policy conducted in several countries which related to business creation.

Keywords: Entrepreneurship Education, Government Policy, Entrepreneurship Programs, Entrepreneurs.

1. Introduction

In Indonesia, entrepreneurship emerged and developed rapidly started in 1998, when economic crisis happened. At that time, economic condition was unpredictable and unstable. There were some companies that have established at long time periods then suddenly bankrupt. Many employees had experienced with employment termination, so that a lot of people has lose their jobs. Nevertheless people who lost their jobs, they have to survive. Sometimes they give up because they were used to be in a comfort zone for so many times. Thus it was a very drastic economic change they could not adapt. Among them there were also who were swerved, person with a certain expertise shift their job and should try another skill in order to generate money and to keep survive. For instance, engineer who become entrepreneurs.

Recently, entrepreneurship is considered as one of alternatives as a career option for young generation. People today do not consider entrepreneurship as an option for them to earn income and generate money, but more than that entrepreneurship is also regarded as one of the ways to uphold their values such as beneficial to society, freedom to manage time and finance, and freedom to define and execute what they want.

Data from the Indonesian Ministry of Manpower and Transmigration showed that in January 2012 the number of unemployed in Indonesia reached 7.5 million people from the 119,39 million people (Pusat Humas Kemnakertrans). Responding to high rates of unemployment in Indonesia, then the value of entrepreneurship is considered very important for the students. Many colleges are making entrepreneurship as a research object, and also inserted it into the curriculum.

In developed countries the growth of entrepreneurship brings tremendous economic improvement. These new entrepreneurs have been enriched with new innovative products. In the 1980s in America was born approximately 20 million new entrepreneurs, they created new jobs. Similarly, in Eastern Europe, these entrepreneurs were emerging.

Even in the land of China, they believe in communism, opening up to the raise of entrepreneur. Beijing University is abolishing the Marxist course, and replacing them with entrepreneurial courses.

Transformation of entrepreneurship knowledge has grown. It was supported by a statement of Ministry of National Education that entrepreneurship better off inserted into the educational curriculum, as a consequence that entrepreneurship can be taught with teaching attitudes and behaviors of started up business. During the last five year, education institution began to offer either formal or informal entrepreneurship. In Indonesia, the emergence of entrepreneurship education has developed rapidly. It was showed by the increasing number of school which offering entrepreneurship program. However, Hatta Rajasa (Coordinating Ministry for Economic Affairs of the Republic of Indonesia) said that the number of entrepreneurs in Indonesia is still small, it around 0,18 percent of population (Basuki and Djumena, 2011).

This paper will discuss development of entrepreneurship which involves the important role of three interrelated parties namely education institution, government, and entrepreneurs. Research methodology includes literature study and bench mark of several universities in the world that offer entrepreneurship program. Analyses were performed to data obtained, furthermore constructed a proposed of interaction model among those three parties.

2. Literature Review

2.1. Why Entrepreneurship is important

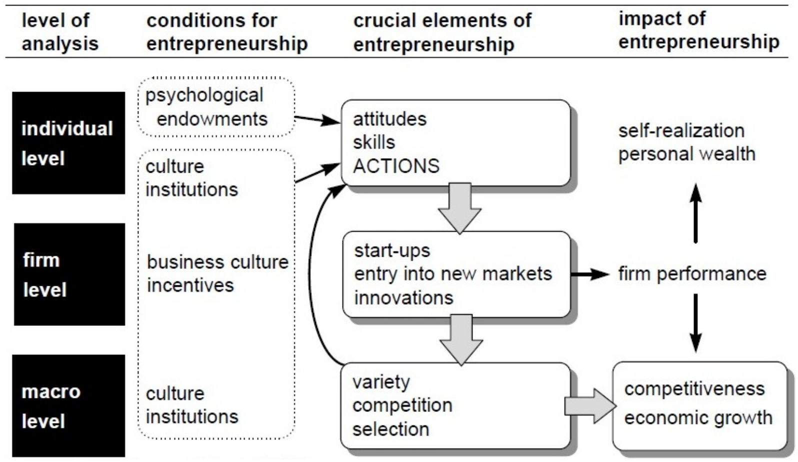
Previous research showed that entrepreneurship is a catalyst for economic growth and national competitiveness (GEM Report, 2010). Specifically, entrepreneurship has a role in increasing prosperity and reducing unemployment. The relationship between entrepreneurship and economic growth has been increased and even better for local, state, and national levels. Recent studies have shown that the contribution of entrepreneurship sector to employment and GDP is increasing (Audretsch & Thurik, 2001; Birch, 1987; Kumar & Liu, 2005 in Minniti, 2008). A significant amount of work has also established that entrepreneurial activity has important social implications (Chell, 2007 in Minniti, 2008).

The contribution or role of entrepreneurship to micro, small, and medium enterprises related to economic growth of a nation has well recognized. Those contributions are following (Leutkenhorst, 2004 in Jahanshahi et al, 2011):

- Generating employment, because they tend to use more labor than large enterprises
- Boosting employment and leading to more equitable income distribution.
- Providing livelihood opportunities through the activities of value adding process
- Nurturing entrepreneurship
- Supporting the building up of systemic productive capacities and the creation of resilient economic systems, through linkages between small and large enterprises

Following is figure that shows framework for linking entrepreneurship to economic growth.

Figure 1. Framework for Linking Entrepreneurship to Economic Growth



Source: Wennekersand Thurik, 1999.

Entrepreneur in individual level, need to have at least attitudes, skill and action so that if they collaborate in firm level, they can create a start-ups, entry into new market, and make innovation. In macro level, they need elements of variety, competition and selection, so they can have a competitiveness that can grow the economic.

2.2. The Role of Government as Policy Makers in order to Develop Entrepreneurship

In mid-1990, policymakers began to identify and to recognize the importance of entrepreneurship. Furthermore the policymakers in several countries including international organizations also began to explicitly recognize the importance of entrepreneurship and create a joint statement about their commitment to improve entrepreneurship and entrepreneurial environment (Lundstrom and Stevenson, (2005), Hart (2003), OECD (2007) in Ahmad& Hoffman, 2007).

Starting from commitment, then they generate tools to measure entrepreneurship performance, such as: Total Entrepreneurial Activities (TEA), it is indicator used to measure the growth rate of entrepreneurial activities in a country per certain time. Another measurement is Entrepreneurship Indicators Programme (EIP) which was developed by the OECD (Organization for Economic Co-operation and Development). The indicators are important because they intend to make improvements. For instance, if from the measurement, government identify some indicators have lower score then government may focus to develop an appropriate policy to improve the lower score indicators and it should aligned with their long-term strategic planning.

In developing entrepreneurship, government policy has a big influence, in order to establish environment and create infrastructure that support entrepreneurship. Therefore government should be alert, observant, and precise to the issue of conducive and productive policy. However the fact that entrepreneurship is positively linked to performance does not justify public policy intervention. Instead, according to Audretsch (2004, in Minniti, 2008) the mandate for public policy intervention can only be the result of fundamental market failures. It is also clear that, when it comes to entrepreneurship policy, one size does not fit all, and that, in the long run, governments can only provide an underlying conducive environment to the emergence of productive entrepreneurship rather than unproductive entrepreneurship. Furthermore government should endeavour to create enabling and conducive environments to the labour and the commercialization of invention, however, too much public involvement, without interest from private sector, can hinder rather than help, entrepreneurs in creating possible market distortions (Minniti, 2008).

The degree of development is also important, and the relationship between policy and entrepreneurial activity varies across countries. Dutz, Ordover, and Willig (2000 in Minniti, 2008) explore the relationships between entrepreneurship and economic development in low-income countries. In this context, they suggest that two policies are critical for promoting growth.

1. Protecting commercial freedom, property rights, and contracts.
2. Fostering opportunities for grassroots entrepreneurship is paramount through an active supply-side competition policy that emphasizing access to essential business services and other required local inputs.

In the end, government policy should not aspire to the elimination of new venture failures. Although painful at the microeconomic level, business churning is part of a healthy economic system. The most important, only the market can determine what the optimal amount of entrepreneurship is. We do not know enough to answer this fundamental question, much less to determine which firms to target for success or failure. Government policy can, however, contribute actively to the development of an institutional setting that encourages productive entrepreneurship (Holtz-Eakin, 2000 in Minniti, 2008).

According to Jahanshahi et al (2011), policymaking in entrepreneurship field is complex and messy. Many areas of government policy affect levels of entrepreneurial activity such as regulatory policies, trade policies, labor market policies, regional development policies, social policies, and even gender policies. This means governments must adopt more horizontal structures for developing and implementing an integrated policy approach. The mix of policy options will depend on a number of factors, including the prevailing attitudes of the population towards entrepreneurship, the structure of the labor force, the size and role of government, the prevalence of existing level of entrepreneurial activity and the existing MSMEs. Entrepreneurs are the driving force behind MSMEs, and MSMEs play an important structural and dynamic role in all economies. The main areas where increased levels of entrepreneurial activity can contribute significantly to specific policy outcomes are:

1. Create opportunities such as job creation, careers, and new products or services
2. Economic growth, productivity improvement, and innovation.
3. Poverty alleviation and social opportunities.
4. Create new customers and open up new markets.

2.3. The Role of Education Institution

Entrepreneurs in this study refers to educated entrepreneur, this is because the educated entrepreneurs were assumed have more potential in developing their business. Educated entrepreneurs are entrepreneurs who have business capabilities and competencies in accordance with their educational background. Educated entrepreneurs are expected to become opportunity entrepreneurs rather than necessity entrepreneurs. Opportunity entrepreneurs are entrepreneurs who decide to run their own business because they see the opportunities and give an added value. However necessity entrepreneurs are entrepreneurs who run their business because they do not have another choice for career and for generate income. Significant differences in characteristics of both entrepreneurs include their mindset to always grow and also give an added value. Opportunity entrepreneurs will always continually looking for the opportunities and increasing their business, they are always persistence to pursue their business opportunity, to fight their dreams, and to sustain their business.

GEM found that necessity entrepreneurship has no effect on economic development while opportunity entrepreneurship has a positive and significant effect. Opportunity based entrepreneurs act upon these insights and the economy becomes more productive because it is able to produce more consumer satisfaction at a lower cost (GEM Report, 2010).

In this regard, education institution aims to be able to bridge the needs of the market, which is creating educated entrepreneurs and increasing the amount of business. To create the educated entrepreneur is not easy. Learning process should integrate between soft skills and knowledge. Furthermore, a comprehensive curriculum is necessary and it should be distinguished from traditional learning process of other subject. Zeithaml and Rice (1987) contended that education in entrepreneurship covered the entire scope of business administration and as such was the closest approach to the original concept of management education available in universities at that time. With the continued increasing fragmentation of business education into narrow specializations, it is believed that a field of study that takes a broad, integrative, pragmatic, and rational approach to business would find itself increasingly popular for those who aspire to be entrepreneurs, managers, and top executives.

Ronstadt (1987) proposed that entrepreneurial programs should be designed so that potential entrepreneurs are aware of barriers to initiate their entrepreneurial careers and can devise ways to overcome them. He proposed a two-continuum model of curriculum design for entrepreneurship education. His “structured–unstructured” continuum addressed various methods of transferring information and expertise. Among the methods he discussed were lectures, case studies, and feasibility plans. He labelled his second continuum “entrepreneurial know-how/entrepreneurial know-who.” This continuum represented the belief that success in entrepreneurship is dependent not only on knowledge but the network of individuals with whom an entrepreneur is connected. Ronstadt (1987) contended that an effective program must show students “how” to entrepreneurially behave and should also introduce them to people who might be able to facilitate their success.

More recent evidence suggests that people who start businesses have a higher level of education than people who do not (Bates, 1995; Bowen &Hisrich, 1986in Peterman and Kennedy, 2003). In particular, the study of census data (Robinson & Sexton, 1994in Peterman and Kennedy, 2003) provides convincing evidence that business owners are more highly educated than the general public.

According to Kuratko (2005), in understanding and teaching of entrepreneurship education there are several things that must be understood namely the sources of entrepreneurial understanding. Sources of entrepreneurial understanding are the process to be better understands the driving forces within entrepreneurs (Bull & Willard, 1993; Bygrave & Hofer, 1991; Gartner, 2001in Kuratko, 2005). There are three major sources of information to supply data related to the entrepreneurial process or perspective. The three sources of information are following:

- The first source is researchbased as well as popular publications
- The second major source of information about entrepreneurial perspective is directobservation of practicing entrepreneurs. Through the use of interviews, surveys, and casestudies, the related experiences of individual entrepreneur. An analysis of theseexperiences can provide insights into the traits, characteristics, and personalities of individualentrepreneurs and leads to the discovery of commonalities that would help explainthe perspective.
- The final source of entrepreneurial information is speeches and presentations (includingseminars) by practicing entrepreneurs. This source may not go as far in-depth as theother two do, but it does provide an opportunity to learn about entrepreneurial perspective.

A core objective of entrepreneurship education is that it differentiates from typical business education. Business entry is fundamentally a different activity than managing a business (Gartner & Vesper, 1994 in Kuratko, 2005); entrepreneurial education must address the equivocal nature of business entry (Gartner, Bird, & Starr, 1992 in Kuratko, 2005). To this end, entrepreneurial education must include skill-building courses in negotiation, leadership, new product development, creative thinking, and exposure to technological innovation (McMullan & Long, 1987; Vesper & McMullen, 1988 in Kuratko, 2005). Other areas identified as important for entrepreneurial education included awareness of entrepreneur career options (Donckels, 1991; Hills, 1988 in Kuratko, 2005), sources of venture capital (Vesper & McMullen, 1988 in Kuratko, 2005; Zeithaml & Rice, 1987), idea protection (Vesper & McMullen, 1988 in Kuratko, 2005), ambiguity tolerance (Ronstadt, 1987), the characteristics that define the entrepreneurial personality (Hills, 1988; Hood & Young, 1993; Scott & Twomey, 1998 in Kuratko, 2005), and the challenges associated with each stage of venture development (McMullan & Long, 1987; Plaschka & Welsch, 1990 in Kuratko, 2005).

2.4. The Role of Entrepreneurs

The role of entrepreneur in developing entrepreneurship can be done in several ways, such as giving mentoring, role model, assistantship, and/or funding (investor). There are a lot of researches concerning the important role of entrepreneurs, the role is important particularly for startup businesses, in which at that stage, entrepreneurs do not have enough experiences to run their business, to calculate the risks, and to create strategies and planning that should be taken to make sure their business grow and sustain. Role model according to Bosma *et al* (2011) is stated below:

1. Role models are viewed as influential persons by a significant proportion of the entrepreneurs who use them in the start-up phase of their venture. Suggest that role models play an important role for entrepreneurs in (young) firms.The dominant function of a role model is 'learning by example', although 'learning by support'. Thus, to promote entrepreneurship as a career choice it is important to bring together potentially aspiring and inspiring entrepreneurs who know each other. The fact that actual support by role models is important for entrepreneurs in the post-start-up phase and is usually provided by family members has been overlooked so far. This may have policy implications since family members may provide an efficient alternative to expensive channels of entrepreneurial support facilitated by (local) governments.
2. A few characteristics of entrepreneurs and their firms determine the use of role models. Individuals who have no previous entrepreneurial experience are indeed more likely to have a role model than those who have previous start-up experience. Moreover, entrepreneurs with higher levels of education are more likely to have a role model and the likelihood that these entrepreneurs view their role models as crucially important is significantly higher.

According to Bosma *et al* (2011), many entrepreneurs claim that their business start-up decision and the development of their business have been influenced by others. These 'others' are often entrepreneurs and may range from famous people such as Steve Jobs to former colleagues or family members. Such persons serve as role models. A role model is a common reference to individuals who set examples to be emulated by others and who may stimulate or inspire other individuals to make certain (career) decisions and achieve certain goals (Shapiro *et al,* 1978; Basow and Howe, 1980; Wright et al., 1997 in Bosma *et al*, 2011).

Role models are increasingly being acknowledged as an influential factor in explaining the reasons for the choice of occupation and career. Various conceptual studies have proposed links between role models and entrepreneurial intentions. As stated by Gibson (2004), "The term 'role model' draws on two prominent theoretical constructs: the concept of role and the tendency of individuals to identify with other people … and the concept of modelling, the psychological matching of cognitive skills and patterns of behaviour between a person and an observing individual". This implies that individuals are attracted to role models who are perceived to be similar in terms of their characteristics, behaviour or goals (the role aspect), and from whom they are able to learn certain abilities or skills (the model aspect).Gibson (2004) summarizes the various functions that role models may fulfil and argues that the importance of role models lies in three interrelated functions: "to provide learning, to provide motivation and inspiration and to help individuals define their self-concept". Nauta and Kokaly (2001) add a support component, arguing that role models not only provide individuals with inspiration and modelling, but also with support and guidance.

3. Research Methodology

This is an exploratory research in the form of literature study concerning collaboration and interaction among education institution, entrepreneurs and government, in order to develop entrepreneurship. Research methodology was done by doing bench mark towards several education institution which offer entrepreneurship course; several country which conduct and apply entrepreneurship policy; and experiences from entrepreneurs who doing mentorship and assistance through business incubator. Data used were analyzed qualitatively and from the result come up several recommendations for all of the parties regardless their priority strategies and programmes.

4. Finding and Discussion

4.1. Education Institution

Benchmark has been done from several universities overseas and Indonesia which offer entrepreneurship program. Following are the result:

Australia

Based on research done by Chan (2005), concerning entrepreneurship education in Australia, finds that the most of the current entrepreneur programs do not distinguish themselves from other academic programs in terms of teaching delivery methods, curriculum, facilities, advertising and promotion. Eentrepreneurship education in Australiais divided into four categories. The first one is simply that universities do not offer any units or programs in entrepreneurship. The next category covers universities which only offer entrepreneurship units as part of the bachelor or masters programs. The third category is those which either offer entrepreneurship bachelor programs or with specialization/major/minor in entrepreneurship. Last of all is those universities which offer the postgraduate programs in entrepreneurship including postgraduate diploma/certificate and master's. Entrepreneurship teachings are similar to other business or commerce programs: theories, applications and understanding the business communities. Entrepreneurship programs mainly study the theories and models on marketing, finance, management, creating real business plans which have been learned in the classroom (applications) and gaining access and insight from leaders in the entrepreneurial business community degree (Chan, 2005).Teaching units commonly contributed to the entrepreneurship programs are Entrepreneurial Ventures, Innovation and Creativity, New Business Ventures, Entrepreneurship Market, Leadership and Managing enterprise.

America

Ball State University is one of the first universities in the country to start an entrepreneurship program. Ball State is a leader in entrepreneurship education. Ball State's entrepreneurship program offers the students who want to use their creativity and determination to solve real-world problems. At the heart of the program is New Venture Creation course. The students will face the ultimate risk as student prepare a thorough business plan which will be evaluated by real-world entrepreneurs and financial professionals and determine whether student graduate. The teacher team will constantly evaluate their methods of teaching and continually improve upon ways to expose students to the real-world pressures of creating and leading businesses. The program emphasizes theories on innovation, creativity, and design with feedback from top-level entrepreneurs and executives. So, the students not only learn fundamental theories behind good business practices and what it takes to run a profitable business, but the students also gain real-world experience through immersive learning projects and working with our business partners.Student who takes entrepreneurship program will learn business knowledge and entrepreneurship skill. Business knowledge covers macro and micro economy, business law, information system, etc, and entrepreneurship skill covers all material related to creativity, innovation, New Venture Creation, and Venture Financing. This program includes entrepreneurship laboratory and entrepreneurship consulting. Entrepreneurship laboratory or in others institution it may be called as a business incubator, comprise all activities related to entrepreneurship experience (Ball State University, n.d).

4.2. Government Policy

Singapore

In Singapore government support entrepreneurship by creating conducive and productive entrepreneurship policy, the policy such as (Singh, 2009):

- Easy access to capital
- Encourage workers to work hard
- Encourage foreign investors to set up plants
- Provide employment opportunities.

Singapore government think that their country is not only need entrepreneurs but also need good quality startups with a global vision and to build the wherewithal to compete in the knowledge economy. As a consequence of their policy, Singapore has a strong macro-economic environment and in every year forms more businesses, from below 36,000 in 2002 to almost 50,000 in 2008. Singapore becomes a truly entrepreneurial nation, where entrepreneurs worldwide are attracted to do business here (Beng and Chew (2001) in Singh, 2009).

America

Between 1996 and 2004 America created an average of 550,000 small businesses every month. Many of those small businesses rapidly grow big. The United States has no entrepreneurship policy. Nor, does it have a small-business policy for that matter. Instead, the United States has an overarching competition policy in which entrepreneurs and entrepreneurial firms play a critical role. It is a competition policy that assigns overwhelming priority to consumer interests and cares little about consequences to individual competitors (The Economist, 2009).

United Kingdom
In United Kingdom during 2005, there were approximately 390,000 business start-ups. Nearly one in three (29%) people have what they thought was a great business idea or invention. It is because there is policy documents focus on innovation and entrepreneurship strategy and the main ministries are involved in both innovation and entrepreneurship (IPREG, 2006).

Australia
Australia is a prosperous Western-style capitalist economy, with a per capita GDP competing with the four dominant West European economies. Between 1997-1998, 45% of gross new jobs in Australia were created by new firms (Stevenson and Lundström, 2001). Despite the global economic downturn in 2001, the Australian economy has maintained a 2.3% GDP growth. This is due to the fact that the domestic economy is offsetting the external slump. Moreover, business and consumer confidence remains intact. Resources are plentiful, unemployment is low, and literacy is at 100% (International Entrepreneurship, n.d). In 2006, for every 100 males there are 70 females engaged in business start-ups.In2007 Australians are the most entrepreneurial people in the developed world with more than 20 per cent of adults running their own business, or planning to start one. Australian government is very support to create new entrepreneur, one of the ways is by conducting business consultation which is one of government program which make the society more opportunities to be consulted about government policies and regulations that may affect the business. It allows Australian to register to receive notifications of new public consultations that are posted by government agencies (Swinburne University of Technology, 2007).
The Australian Government provided $2 million for a new initiative that encourage young Australians to take an enterprising approach to their learning in secondary schools and the Australian Government was committed to building an enterprising culture within Australia (DEST 2005 in Chan, 2005), with the support by the government and the need established through social trend, there will be huge potential markets for entrepreneurship education (Chan, 2005).

Indonesia

Following are general condition in business' environment in Indonesia. This result is based on data from The Global Competitiveness Report 2011–2012 stated that the most problematic factors for doing business which are gained from perspective of entrepreneurs in Indonesia are: corruption, inefficient business bureaucracy, inadequate of infrastructure, policy instability, access to financing, inadequately educated workforce, ,poor work ethic in national labor force, government instability, etc. Three top priorities for government in order to improve the business environmental should be more focus in corruption, bureaucracy, and infrastructure.

4.3. Entrepreneurs

Involvement or participation of entrepreneurs can be applied and done in such activities like business mentoring, assisting, and giving motivation in business incubator. Business mentoring and assisting is important for new entrepreneurs to get the insight and experience from real entrepreneurs. In the process of entrepreneurship, mostly new entrepreneurs need a role model as their trainer to run their business. As entrepreneurs, the big challenges for them are facing risks and unpredictable condition. Sometimes they lose and sometimes they gain profit. Therefore they need to nurture their emotion by sharing their business problem and getting motivation. In Indonesia, there are around 45-50 business incubators in universities and only a half of it which is active (Munthe, 2012).

There are several business incubators in Indonesia such as:

- Batavia Incubator, aim to grow up together with young talented tech start ups in Indonesia, to supply not only seed funding capital, internet business models and strategies, and financial schemes including IPO guidance, which all based on long years experience, do-how, and global networks (Batavia Incubator, 2011).
- Global Entrepreneurship Program Indonesia (GEPI) is an umbrella organization that aims to work in partnership with many organizations and companies that focused on developing entrepreneurship in Indonesia (Global Entrepreneurship Program Indonesia, 2011).

- Kinara Indonesia, their programs are helping finding capital and creating strategic partner which support consultations such as finance management, channel distribution, and collaboration between small business and expertise in related area in order to develop entrepreneurship (Kinara Indonesia, 2011).

5. Conclusion and Recommendations

In order to develop and to improve entrepreneurship in Indonesia, it should collaborate among those three parties, namely education institution, government, and entrepreneurs, and each party has their own role. Learn from the experiences, Entrepreneurship can be taught by constructing multidiscipline curriculum. The curriculum should comprise of entrepreneurship theories and practice include business knowledge (macro and micro economy, business law, information system, etc); and entrepreneurship skill (all material related to creativity, innovation, new venture creation, and venture financing). Entrepreneurship program should be differentiated from other program in term of learning methods, entrepreneurship program should be conducted in lecturing, practicing, mentoring, and assistantship with academician as well as entrepreneurs.

The role of entrepreneurs can be applied in the form of business incubator. Presently, business incubator still has to be improved in order to develop entrepreneurship in Indonesia. The role of business incubation can significantly help improvement in product quality of business and management skill of new entrepreneurs. Government policy should focus on the ease of doing business in Indonesia. Business's trust to government performance as policy makers should always be maintained. To solve the most problematic factors for doing business, government's priorities should be related to alleviate corruption, bureaucracy, and improve infrastructure quality.

References

Ahmad, N. and Hoffman, 2007. A Framework for Addressing and Measuring Entrepreneurship. OECD Statistics Working Papers. 2008/01. OECD Publishing.

Basuki, O. and E. Djumena, 2011. "Jumlah Entrepreneur Hanya 0,18 Persen". Retrieved on May 1, 2012 from http://bisniskeuangan.kompas.com/read/2011/01/26/13375892/Jumlah.Entrepreneur.Hanya.0.18.Persen.

Ball State University, n.d. The Entrepreneurship Center. Retrieved on May 1, 2012 from http://cms.bsu.edu/Academics/CentersandInstitutes/EntrepreneurshipCenter.aspx

Batavia Incubator, 2011. "We are Teach Start Up Incubator". Retrieved on May 1, 2012 from http://www.batavia-incubator.com

Bosma N., J. Hessels, V. Schutjens, M. Praag, and I. Verheul, 2011. Entrepreneurship and Role Models.Tinbergen Institute Discussion Papers 11-061/3. Tinbergen Institute

Chan, S.K., 2005. Entrepreneurship Education in Australia-A Preliminary Study. *Journal of Asia Entrepreneurship and Sustainability.*

Gibson, D.E., 2004. Role models in career development: New directions for theory and research. *Journal of Vocational Behavior*. 65.

Global Entrepreneurship Program Indonesia, 2011. "About". Retrieved on May 1, 2012 from http://gep-indonesia.org

International Entrepreneurship, n.d., "Australia", Retrieved on May 1, 2012 from http://www.internationalentrepreneurship.com/pacific/australia/.

Jahanshahi, A. A., K. Nawaser, S. Mohammad, S. Khaksar, A. R. Kamalian, 2011. The Relationship between Government Policy and the Growth of Entrepreneurship in the Micro, Small & Medium Enterprises of India. *Journal of Technology Management & Innovation*, 6 (1).

Kinara Indonesia, 2011. Leading Incubator Business in Indonesia. Retrieved on May 1, 2012 from http://kinaraindonesia.com/

Kuratko, D. F., 2005. The Emergence of Entrepreneurship Education: Development, Trends, and Challenges. *Entrepreneurship Theory and Practice.*

http://www.ipreg.org.uk/

Leutkenhorst, J., 2004. Corporate Social Responsibility and the Development Agenda: The case for actively involving small and medium enterprises. *Inter economics*.

Lundström, A and L. Stevenson, 2005. Entrepreneurship Policy – Theory and Practices. ISEN International Studies in Entrepreneurship. Springer.

Minniti, M., 2008. The Role of Government Policy on Entrepreneurial Activity: Productive, Unproductive, or Destructive?, *Entrepreneurship Theory and Practice*, 32 (5).

Munthe, M.G., 2012, "Inkubator Bisnis: Perannya Bakal Dioptimalkan", Retrieved on May 1, 2012 from http://www.bisnis.com/articles/inkubator-bisnis-perannya-bakal-dioptimalkan.

Nauta, M. and Kokaly, M, 2001. Assessing role model influences on students' academic and vocational decisions. *Journal of Career Assessment*. 9 (1).

Peterman, N.E., and J. Kennedy, 2003. Enterprise Education: Influencing Students' Perceptions of Entrepreneurship. *Entrepreneurship Theory and Practice.*

Pusat Humas Kemnakertrans, n.d., Muhaimin : Tahun 2012, Angkatan Kerja Bakal Menjadi 119,39 juta orang Retrieved on May 1, 2012 from http://www.depnakertrans.go.id/?

Ronstadt, R., 1987. The Educated Entrepreneurs: A New Era of Entrepreneurial Education is Beginning. *American Journal of Small Business*, *11*(4).

Schumpeter, J.A., 1934. The Theory of Economic Development. Cambridge, MA: Harvard University Press.

Singh, I., 2009. "Singapore As A Hub For Entrepreneurs". Retrieved on May 1, 2012 from The Business Times. http://business.asiaone.com/Business/SME%2BCentral/Talking%2Bpoint/Story/A1Story20091119-181040.html

Stevenson, L. and A. Lundström, 2001, Patterns and Trends in Entrepreneurship/SME Policy and Practice in Ten Economies, Entrepreneurship Policy for the Future Series. (3). Swedish Foundation for Small Business Research.

Swinburne University of Technology, 2007. Australia: world's best entrepreneurs. Retrieved on May 1, 2012 from http://www.sciencealert.com.au/news/20072311-16631-2.html

The Economist, 2009. "The United States of Entrepreneurs". Retrieved on May 1, 2012 from http://www.economist.com/node/13216037

The Global Competitiveness Report 2011–2012.

Wennekers, S and R. Thurik, 1999. Linking Entrepreneurship and Economic Growth. *Small Business Economics*, 13-1. DOI: 10.1023/A:1008063200484

Zeithaml, C.P. and Rice G.H., 1987. Entrepreneurship/Small business education in American universities. *Journal of Small Business Management*, *25*(1), 44–50.

IDENTIFICATION AND PRIORITIZATION OF FACTORS AFFECTING ENTREPRENEURSHIP DEVELOPMENT IN ONLINE STORES

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Abstract
The advancement of technology has influence the way people do business. Last few years, numbers of online stores in Indonesia increases and suddenly everyone can open a new business as long as he or she has internet access. Online stores are considered as Small Medium Enterprises because the size of business is still small but keep growing. Previous research already identify factors affecting entrepreneurship development in other area of business and country and this study is going to focused on Indonesian people who have online stores. The main findings of this study are identification and prioritization of factors affecting entrepreneurship development in online stores. Three factors affecting the development of entrepreneurship are individual factors, environment factors, and policy factors. By knowing the prioritization of these factors, we can recommend actions that can be done in developing Indonesians's entrepreneurship in doing online business and how government and universities can be prepared to give assistances in developing this growing business opportunities.

Keywords: entrepreneurship development, small medium enterprises, online stores

1. Background

6. One way to increase a nation's wealth and it's people welfare is through an increase number of entrepreneur. By increasing the number of entrepreneur, automatically will increase the number of jobs created. By 2011,the number of Indonesian entrepreneur is only 0,18% from Indonesian population (Kompas, 2011). The advancement of technology, especially mobile and internet technology have open more opportunities for people to get more dan faster information. People who recognize those opportunities can gain more money by make business using those technology and social media. Social media has growth rapidly these recent years. Indonesia is now the world's second largest market for Facebook and the third largest for Twitter, according to several web research firms (http://www.economist.com/node/17853348). Jakarta Globe mentioned that Indonesia is an era of social network, so ways doing business and marketing are swifting towards a digital era (http://www.the jakartaglobe.com). This research is going to identify factors that affecting digital entrepreneur in Indonesia by using factor analysis to find those factors.

2. Literature Review

2.1 Digital Entrepreneurship

The advancement of technology, both communication and information technology create more opportunities for people become an entrepreneur. New information-bassed technologies have long generated opportunities for entrepreneurs to create high-tech businesses (Robert, 1991). Digital entrepreneurship means diverse opportunities generated by inernet, mobile technologies, world wide web, and other new medias (Mirshamsi et al., 2011). Digital entrepreneur is wave of initiatives where companies or individuals develop new business models based upon the growth of social networks and mobile technologies (Davidson and Vaast, 2010). Davidson and Vaast also mentioned that there are three forms of entreprenurial opportunities and sociomaterial practices within and between each form of opportunity exploitation that can provide a useful platform to build inquiries into new ventures emerging in digital economy (Davidson and Vaast, 2010). The three forms of entreprenurial opportunities in digital entrepreneurship are business, knowledge and institutional entrepreneur. So, digital entrepreneurship are ability to pursue new venture opportunities presented by new media and internet technologies (Davidson and Vaast, 2010).

According to Davidson and Vaast, in becoming a digital entrepreneur, one need to bear risk of new profit seeking venture (business entrepreneurship), theorize new practices discursively and through action (institutional entrepreneurship), and innovate new fields of knowledge and improve them (knowledge entrepreneurship) (Davidson and Vaast, 2010).

2.2 Factors Affecting digital entrepreneurship development

Previous researcher mentioned about factors affecting digital entrepreurship development. In their reserach about digital entrepreneurship development in Iran, Mirshamsi et al. use three factors which are co-structural factors, content factors, and context factors (Mirshamsi et al., 2011). In 2009, Vijaya and Kamalanabhan conduct a research using factor analysis and make a scale to assess entrepreneurial motivation in India. According to their reseach, five factors that affecting entrepreneurial motivation are entrepreneurial core, social core, individual core, and economic core (Vijaya and Kamalanabhan, 1999). Meanwhile, other reseach conducted by Turker and Selcuk mentioned that the most important things are educational and structural support (Turker and Selcuk, 2009). This research will explore not only factors that motivate but all about factors that affecting digital entrepreneurship.

3. State of The Art

Vijaya and Kamalanabhan's research using factor analysis to find factors that affecting entrepreneurial motivation showed that co structural factors such as administrative laws and regulations related to ICT was the first factor that affecting digital entrepreneurship development in Iran. While Mirshamsi et al. 's research is about finding and prioritization of factors affecting digital entrepreneurship develepment. Previous researchers have done some research about factor affects digital entrepreneurship development and motivation. But only few mentioned about factors affecting digital entrepreneurship development. Most of previous research explore factors affecting entrepreneurship, so this research will focus in exploring factors that affecting digital entrepreneurship by using factor analysis as tools.

This research use factors from Vijaya and Kamalanabhan's reseach and other factors from previous reseacher that relevant to the purpose of this research. Factors used in this research can be seen in table bellow.

Table 1: Facttors predicted to affect digital entrepreneur based on previous researchers

Factors predicted to affect digital entrepreneur	References
Entrepreneurial	Vijaya and Kamalanabhan (1999), Raman et al. (2008)
Work	Vijaya and Kamalanabhan (1999)
Social	Vijaya and Kamalanabhan (1999)
Economic	Vijaya and Kamalanabhan (1999)
Individual	Vijaya and Kamalanabhan (1999), Raman et al. (2008)
Technology	Vijaya and Kamalanabhan (1999)
Regulation	Turker and Selcuk (2008)
Education	Turker and Selcuk (2008)

Based on factors above, questionnaire was built and distributed to respondents. Respondents for this research are those who have business by using internet or mobile technology as media especially online shop as one example of digital entrepreneurs.

4. Methodology

7. This research is using quantitative approach which explore factors affecting digital entrepreneurship by distributing questionnaires to respondent. This research's population are digital entrepreneurs especially those who have their own business using internet or communication technology as their business media. The questionnaire consists of two parts. First is about descriptive of the respondents and in second part, each respondent is asked about their reasons in choosing digital entrepreneurship as their career. The questionnaire use likert scale from 1 (very disagree) to 5 (very agree).

8. Validity and reliability are tested using SPSS 17. Validity is tested by looking to KMO's score from factor analysis. If KMO score is greater than 0.5 means that the questionnaire are valid. Meanwhile, Cronbach's Alpha is used to measure the questionnaire's reliability. The questionnaire item will be said as reliable if the Cronbach's Alphas core is greater than 0.6. Bellow is list of variables used and item questions in distributed questionnaire**.**

Table 2 : Variables and questions in idetifying factors affecting digital entrepreneur

Variable	**Item questions**	**Item Code**
Entrepreneurial core	I want to be independent	Q1
	I want to provide good service or products to the community	Q2
	I want to help consumer to find goods they needed	Q3
	I want to help people by providing them employment	Q4
Work	I want to get complete job satisfaction	Q5
	I want to utilize my keen business sense	Q6
	I want to do something innovative or creative	Q7
	I want to use my decision making or problem solving skills to profit in a career	Q8
	I want to compete with others and prove to the best	Q9
	I want to achieve something that others usually do not	Q10
Social	I want to be a leader	Q11
	I want to be an employer, not only and employee	Q12
	I want to get a higher social status	Q13
	I want to show that I am inferior to none	Q14
	I want get over monotony and get new experience	Q15
Economic	I want to get additional income	Q16
	I want to get best monetary returns because of my ability	Q17
	I want to ensure my family financial stability	Q18
	I want to be able to buy anything I want	Q19
Individual	By doing this business I want to be able to live my life the way I want	Q20
	I choose internet as my business media because many people use social media	Q21
Technology	I choose internet as my business media because many people use internet	Q22
	I choose internet as my business media because of more affordable internet cost	Q23
	I choose internet as my business media because lately more people like shopping online	Q24
	I choose internet as my business media because by doing that I don't need a lot of capital	Q25
	Using internet as business media are supported by government regulation	Q26
Regulation	Getting loan from bank to digital entrepreneur are easy	Q27
	Tax regulation for digital entrepreneur are stated clearly by the law	Q28
	I choose to be a digital entrepreneur because of my educational background	Q29
Education	I choose to be a digital entrepreneur because of the support from my previous school (university or latest education)	Q30
	My educational background influence me in developing creative idea in my business	Q31

5. Result

5.1 Descriptive Statistic

Questionnaires are distributed via internet to digital entrepreneurs especially those who sell products using internet. There are 80 questionnaire collected but only 67 that are used. This number of sample is considered as adequate because it's already greater than 30 respondents, although there's other sources mentioned about minimum number of respondents for factor analysis is ten times of number of variables used.

From 67 questionnaires, 88% of the respondents are female and the rest 12% are male. Most of the respondents started their business around 1-2 years ago and 27% of respondents started their business less than a year ago. Only 1% of respondents have online business more than 4 years old.

Figure 1. Gender

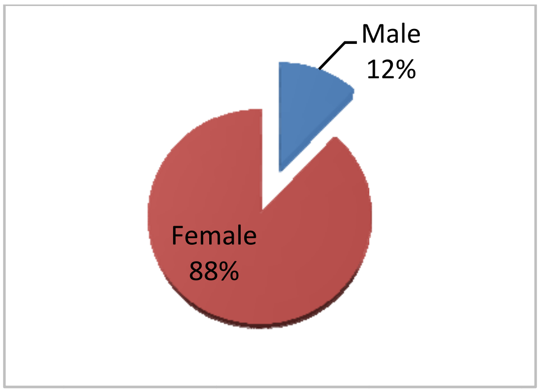
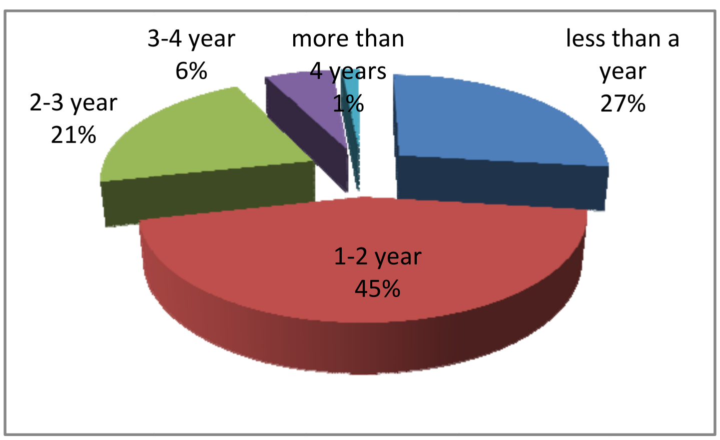
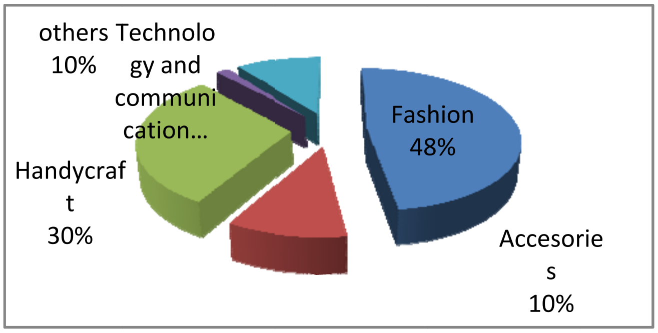


Figure 2. Age of Business



Most of respondents have online business in fashion, followed by handycraft sector which is 30% of the respondents.

Figure 3. Business Sector



5.2 Reliability and Validity Analysis

To test the validity of the questionnaire, SPSS 17 was used and the result were valid because the KMO's score is 0.909 which is greater than 0.5. The reliability of the questionnaire is tested by using Cronbach's Alpha. All questionnaire are reliable because of the Cronbach's Alpha score is greater than 0.8. the Cronbach's Alpha score is 0.992.

5.3 Factor Analysis

Data collected was subjected to factor analysis as principal components method. Normalized varimax rotation were computed using SPSS 17. There are three factors emerged, with maximum factor loading 0.83 and minimum factor loading 0.2. Categorization into three factors can be seen in table bellow.

Table 3: Factor Analysis

Item code	Item Questions	Factors
Q14	I want to show that I am inferior to none	Individual needs and trait
Q10	I want to achieve something that others usually do not	
Q03	I want to help consumer to find goods they needed	
Q02	I want to provide good service or products to the community	
Q11	I want to be a leader	
Q13	I want to get a higher social status	
Q09	I want to compete with others and prove to the best	
Q08	I want to use my decision making or problem solving skills to profit in a career	
Q07	I want to do something innovative or creative	
Q12	I want to be an employer, not only and employee	
Q05	I want to get complete job satisfaction	
Q04	I want to help people by providing them employment	
Q06	I want to utilize my keen business sense	
Q15	I want get over monotony and get new experience	
Q01	I want to be independent	

Q23	I choose internet as my business media because of more affordable internet cost	Lifestyle
Q24	I choose internet as my business media because lately more people like shopping online	
Q25	I choose internet as my business media because by doing that I don't need a lot of capital	
Q22	I choose internet as my business media because many people use internet	
Q21	I choose internet as my business media because many people use social media	
Q16	I want to get additional income	
Q19	I want to be able to buy anything I want	
Q17	I want to get best monetary returns because of my ability	
Q18	I want to ensure my family financial stability	
Q20	By doing this business I want to be able to live my life the way I want	
Q30	I choose to be a digital entrepreneur because of the support from my previous school (university or latest education)	Education and regulation
Q29	I choose to be a digital entrepreneur because of my educational background	
Q28	Tax regulation for digital entrepreneur are stated clearly by the law	
Q27	Getting loan from bank to digital entrepreneur are easy	
Q26	Using internet as business media are supported by government regulation	
Q31	My educational background influence me in developing creative idea in my business	

The first factors are named as individual needs and traits because it consists of item that related to business owners needs and value. The second factors consists of ten items and named as lifestyle because it consists of items that related to one's point of view on what's new and important in both technology and financial. The last factors is education and regulation which define items related to educational background and goverment regulation.

6. Conclusion

Previous reseachers have done research in finding factors affecting entrepreneur but only few that conducts reseach in order to find factors affecting digital entrepreneur. These past years, technology as grow so much and some how affecting the way people or entrepreneur do business. Using factor analysis, this reseach finds that there are three factor that influence digital entrepreneur do their business. Those factors are individual needs and traits, lifestyle, and education and regulation factors.

7. Policy Implication and future research

People can see what are factors that influence digital entrepreneurs and considering these factors in developing policy related to digital entrepreneurs's growth and development. This research is not without limitation. The limitation of this research is that this research mainly focus on digital entrepreneurs that sell their products by using internet as respondents while digital entrepreneurs is not merely about selling things through internet. Other limitation is number of respondents. Some researchers mentioned that the larger number of respondent is the better, some mentioned an adequate number of respondents is ten times number of factors. Future research might evaluate other kind of digital entrepreneur or even all kinds of digital entrepreneur with larger sample size. This research simply mentioned about factor influencing digital entrepreneur but not showing which factors that affect digital entrepreneur's in doing their business. Future research might evaluate which factors affecting digital entrepreneurs.

References

Davidson, Elizabeth. Vaast, Emmanuelle. 2010. Digital Entrepreneurshop and its Sociomaterial Enactment. *Proceedings of the 43rd Hawaii International Conference on System Sciences*.

Gibson, Lloyd G., Gibson, Regina A., Zhao, Shuming. Factors affecting entrepreneurial attitudes of american an chinese business students. 2011. Proceedings of USASBE. Page 1027.

http://bisniskeuangan.kompas.com/read/2011/01/26/13375892/Jumlah.Entrepreneur.Hanya.0.18.Persen%20tanggal%202%20desember%202011

http://www.economist.com/node/17853348

http://www.thejakartaglobe.com/home/indonesias-social-media-obsession-seen-changing-rules-of-marketing/416821

Mirhamsi, Fatemeh. Kord,Baqer. Kamalian, Amin Reza. Yaghoobi,Nour Mohammad. Identification and Prioritization of factors Affecting Digital Entrepreneurship Development (Case Study at Mashhad City-Iran). 2011. European Journal of Social Sciences. Vol. 26 No.3, Pp. 370-388.

Raman, Kavitha., Anantharaman, Jayasingam, R.N.Sharmila. Motivational Factors Affecting Entrepreneurial Decision: A Comparison between Malaysian Women Entrepreneurs and Women Non Entrepreneurs. 2008. Communication of The IBIMA. Vol.2.

Turker, Duygu. Selcuk, Senem Sonmez. 2009. “Which factors affect entrepreneurial intention of university students?”. Journal of Eurpopean Industrial Training. Vol. 33, No. 2, pp.142-159.

Vijaya, V. Kamalanabhan, T.J. 1998. “A Scale to Assess Entrepreneurial Motivation”. Journal of Entrepreneurship. Vol. 7. Pp. 183. Sage Publication

SUCCESS FACTOR FOR BUSINESS INCUBATOR IN CREATING SUCCESSFUL STARTUP FIRMS: DEVELOPING A NEW PROCESS MODEL FOR NEW BUSINESS INCUBATOR IN INDONESIA

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Abstract
Business incubator is an organization that systemizes the process of creating successful new enterprise by providing them with a comprehensive and integrated range of services. (Manan and Yunos 2001). Incubators are intended to provide new firms with the supportive network necessary to increase their profitability of survival during the crucial early years when they are most vulnerable. (Neal Young 2001). Up until now there are 23 business incubator which still in operation. Most of Business Incubator in Indonesia was established by Universities (72%), which the rest was established by Private Sector (21%) and Governmental Institution (7%) (Bank Indonesia, 2006). Having the fact that some business incubator in Indonesia are still underdeveloped, here are some factors hampering the rising of successful business incubator in Indonesia: (a) limitations in providing operational facilities (b) limitations in providing seed capital for new tenants (c) limitations in government commitment and support to develop the business incubator. (Junaidiakhmad, et all, 1997).
In Addition, Hackett &Dilts (2004) says that in order to help draw attention to the underlying attributes of successful new venture development in an incubator environment, the business incubator should focus on the process of incubation rather than on the incubator facility and its design.

Keywords: Business Incubator, Startup Firms

Introduction

Business incubator is an organization that systemizes the process of creating successful new enterprise by providing them with a comprehensive and integrated range of services (Manan and Yunos 2001). Incubators are intended to provide new firms with the supportive network necessary to increase their profitability of survival during the crucial early years when they are most vulnerable (Neal Young 2001). Up until now there are 23 business incubator which still in operation. Most of Business Incubator in Indonesia was established by Universities (72%), which the rest was established by Private Sector (21%) and Governmental Institution (7%) (Bank Indonesia, 2006). Having the fact that some business incubator in Indonesia are still underdeveloped, here are some factors hampering the rising of successful business incubator in Indonesia: (a) limitations in providing operational facilities (b) limitations in providing seed capital for new tenants (c) limitations in government commitment and support to develop the business incubator (Junaidiakhmad, et all, 1997).

In Addition, Hackett &Dilts, 2004 says that in order to help draw attention to the underlying attributes of successful new venture development in an incubator environment, the business incubator should focus on the process of incubation rather than on the incubator facility and its design.

Literature Study

Harman and Read (2003) thinks that incubation is now viewed as a key component of regional and national economic development strategies, supporting and accelerating growth across all sectors. However, it is now recognized that the creation of incubators per se is not sufficient for the development of a supportive environment, which is conducive to the growth of new firms (Khavul et al. 1998).

Though Allen and McCluskey (1990) state that a business incubator is a facility that provides affordable space, shared office service, and business development assistance in an environment conducive to new venture creation, survival, and early stage growth, emphasis is now being placed upon the importance of the incubation process and the more intangible qualities related to business support, access to networks and the development of management teams that underpin firm development. (Khavul, S., Brush, C. G., Kalish, S., & Lerner, M. (1998). In spite of that, the majority of literature to date has focused more upon the outputs of the incubation process, for example income generated, jobs created and/or rates of firm survival (Campbell 1989; Lyons 1990), than the process that has created such outcomes (Mian 1997; Albert and Gaynor 2003). As an addition, Autio and Klofsten (1998) assert that the existing literature is dominated by the structure, context and systems of an incubator than the process of interaction that takes place between firms and between a firm and third parties within the incubator.

Lately, some researches in business incubator process have already been executed. For instance, Rice (2002) uses interdependent co-production modeling to investigate the relationship between the incubator manager and business owners and found that the incubator manager's skill in determining the timing and frequency of business support intervention and preparing businesses to exploit such activity is critical to the business development process. Hansen et al. (2000), used network theory to argue that it is the degree to which incubator firms integrate with one another and the external business community that underpins successful incubation. D. Patton, L. Warren, D. Bream (2009), used single case study approach to indicate that some of the salient factors that strengthen the incubation process include; a steady flow of new ideas, an empathy with founders, the creation and maintenance of internal and external networks and appropriate exit strategies for firms leaving the incubator. And last but not least, Hackett and Dilts (2007) provide data on business incubation outcomes that are very useful for incubator planning and benchmarking purposes. Their research also provides empirically based refinements to a theoretical model of the incubation process.

Proposed Study

This study is conducted to discover the success factor for Indonesian business incubator in creating startup firm, in detail, to develop a new appropriate process model for new business incubator in Indonesia. The factor of the business incubation process, which are going to be quantitatively measured with the incubator manager, business founder and external and internal networks are adapted from the Hackett and Dilts (2007) actual incubation process model and qualitative research from Indonesian business incubator which already begin their operation conducted by author. The end of this study will be a new comprehensive incubation process model for a new business incubator in Indonesia.

The framework of this study described below;

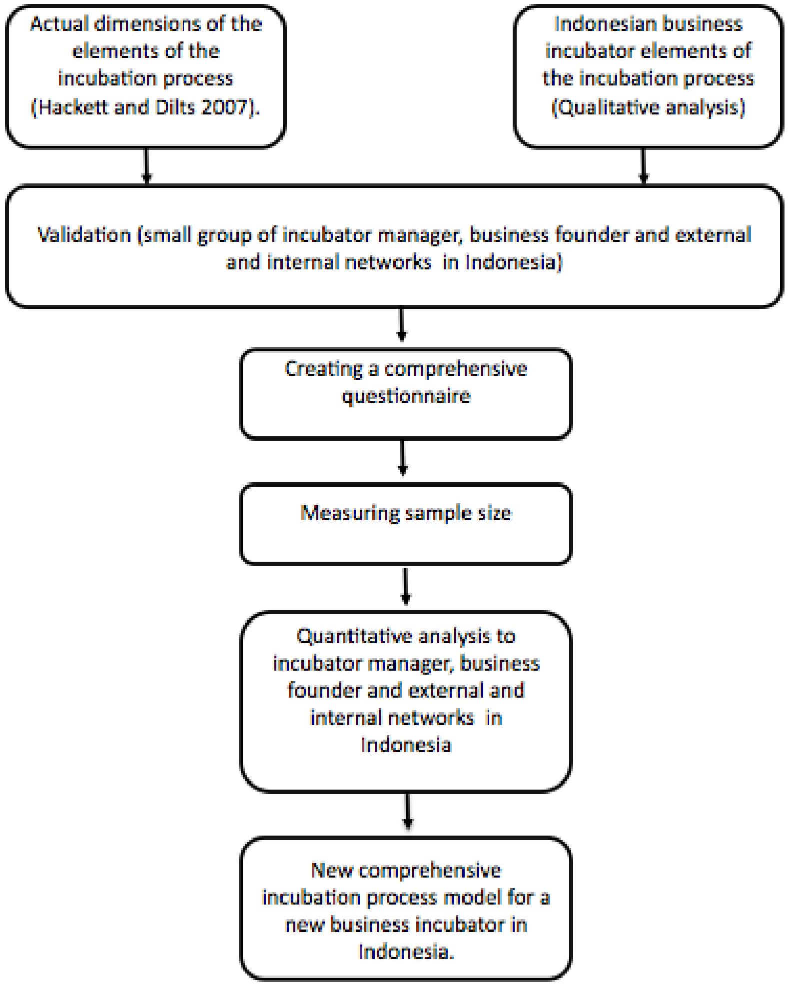

Fig. 1 Framework of the study

Background

The role or Micro, Small and Medium Enterprises (SME) in Indonesian Economic are increasing, especially after the 1997 crisis. SME's, which already be the part of national business world, have some positions, potencies, and also important and strategic roles in creating the balance of national economic structure. In crisis time, SME's were still shown their capability in facing it; meanwhile some big enterprises were slumped by the foreign loans.

Based on BadanPusatStatistik Indonesia year 2005-2009, we can see that the numbers of micro enterprises are the highest among the small, medium and big enterprise. The definition of micro enterprise itself is the enterprise, which owned by individual or individual business entity that has resources at most 50 million rupiah not include the land and building, and also has annual net revenue at most 300 million (Undang-UndangNomor 20 Tahun 2008).

Despite of being the largest number in Indonesia (Fig 2), micro enterprises are still not giving a big contribution to Indonesians Gross Domestic Product. In contrary with its rapid growth in its emersion, the growth of the business itself is not significantly visible. This problems also faced by the small enterprise in Indonesia. They are facing some constraints in order to develop their business to get bigger. The constraints include: the lack of fund, the lack of resource and the lack of business knowledge.

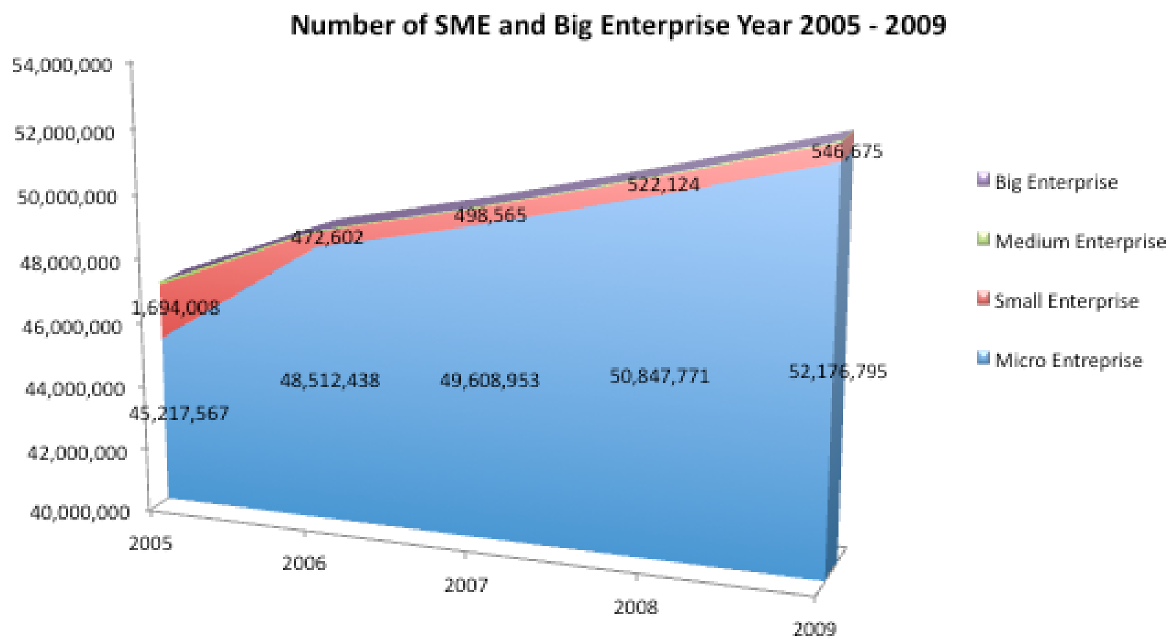

Fig. 2 Number of SME and Big Enterprise Year 2005-2009

Development of micro, small and medium enterprise could be obtained through many ways, one of the solution is by virtue of business incubator. The role of business incubator can be very strategic since business incubator could create a new field of work, creating some new businesses, and become a place to implement particular innovations resulted by some parties (Bank Indonesia, 2006). Generally, business incubator is the organization that provides the infrastructure and services, which can increase one's business value add. In practice, business incubator give supports in education, training and internship which supported by facilities and technology access, management, market review, access to source of fund, and also some general and specific information.

Up until now there are 23 business incubator which still in operation in Indonesia. Each of it has different business model, infrastructure, services and also different business process (http://www.i-tech.or.id/index.php/in/news/72-mou). With that small number of business incubator, apparently not 100% business are giving their best result after the incubation process. The success of incubation process could only occur between 40-70% from 100% tenant at the end of the incubation process (Bank Indonesia, 2006).

It is clear that, even though, most of the business model and incubation process model using and develop the model from the business incubator in developing countries, some business incubation operations in Indonesia are still not optimal. Based on Study of Business Incubator in the aim for SME's Development implemented by Biro Kredit Research and Development Bank Indonesia 2006, there are some strategies that can be done in order to optimize the performance of business incubator in Indonesia:

1. Reinforcement of capacity building in some available business incubators
2. Development of Incubator Model (IM)
3. Development of new business incubator

Replicating the incubator model that continuously modified could carry out the development of new business incubator(Bank Indonesia, 2006).Some research needs to be developed in order to create the best incubation model, which appropriate for new business incubator in Indonesia. While much has been written about business incubators, few studies have examined the incubation process itself. Some literature indicates that a more developed understanding of the underlying processes of incubation and the types and timing of interventions may be critical for achieving accelerated firm growth than the creation of an incubator infrastructure (Khavul 1998; Reid and Garnsey 1998; NBIA 1997). The study regarding the elements of incubation process is already conducted through “A systematic review of Business Incubation Research” (Hackett and Dilts 2004b) and “Inside the Black Box of Business Incubation: Study B-Scale Assessment, model refinement and incubation outcomes” (Hackett and Dilts 2007).

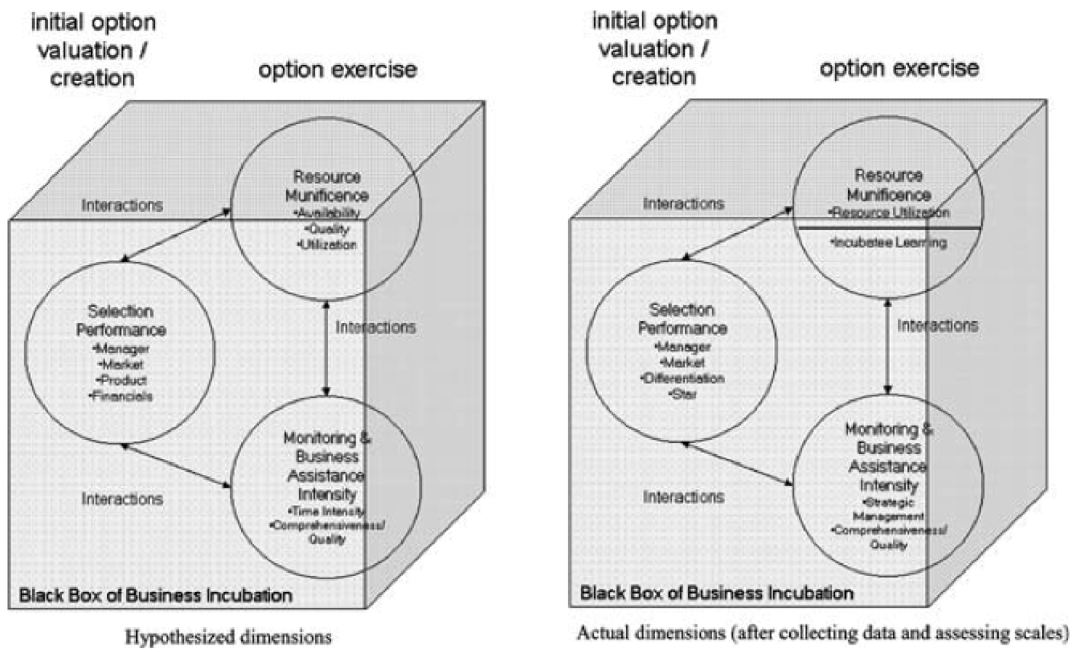

Fig. 3 Hypotized and actual dimensions of the elements of the incubation process

(Hackett and Dilts 2007).

Based on the study, the business incubation process can be captured as: selection performance, monitoring and business assistance intensity and resource munificence. Hackett and Dilts also determine the sub important factor in creating a good incubation process (Fig. 3). Moreover, Hackett and Dilts (2007) study offers (1) new, validated scales for measuring the process of incubating new ventures, (2) empirically-based refinements to a theoretical model of the incubation process, and (3) data on business incubation outcomes that are very useful for incubator planning and benchmarking purposes.

However, since the study is conducted in USA, author could not guarantee the appropriateness of the implementation business incubation process by Hacket and Dilts (2007) in Indonesian business incubator. According to that, author will combine the elements of the incubation process determined by Hackett and Dilts (2007) and elements of the incubation process obtained from the research held among Indonesian business incubator that already begin their operation.Conformity study to some business incubator in Indonesia will be conductedand author will try to find theelements that most affecting the performance of successful incubation process. The end of this study will be a new comprehensive incubation process model for a new business incubator in Indonesia.

Research Objectives

The aims of this research are:

1. To delve the elements of incubation process by combining the elements of incubation process in Indonesia with elements of incubation process by Hacket and Dilts (2007) and get it validated
2. To find the most affecting factor in creating the successful Indonesian business incubation outcome
3. To develop a new appropriate business incubation process model for Indonesian business incubator

Research Methodology

The answer to the general research question will be given through the investigation of the subsequent research issues by:

1. Investigating the Incubation Process in Indonesia by conducting qualitative research
2. Benchmarking the Incubation Process in Indonesia with Hacket and Dilts (2007) incubation process model
3. Finding the best practice for Indonesian business incubation process by conducting quantitative research
4. Developing a new appropriate business incubation process model for Indonesian business incubator

Gradually, author will conduct some steps in order to complete the study as follow:

1. **Data and Information Collection**
   Data collection is conducted through a literature review and some references that related to development of business incubator and SME's. In other hand, the study will also review some regulations that related to business incubator and SME's in the form of laws or government regulation. The literature review also determine the factors that already validated from previous research Hacket and Dilts (2007). As an addition, interview and observation among business incubator stakeholders are also conducted.
2. **Focus Group Discussion (FGD)**
   Focus Group Discussion (FGD) will be held by inviting parties that have some competencies in giving some feedback of business incubation process. Respondent will be determined by structured sampling method, start from the founder, incubator manager, external and internal networks.
3. **Questionnaire pre-testing**
   Pre-testing of the scale items is required prior to implementing the pilot and field tests (Malhotra and Grover 1998). Questionnaire pre-testing will be held among founder, incubator manager, external and internal networks related to business incubator activity with minimum sample size of 30 respondents. Preliminary data analysis includes a visual inspection of the data, common methods variance testing, identification of outliers, and an assessment of the central tendencies of the data (Hair et al. 1998; Lewis-Beck 1995; Rosenzweig 2003).
4. **Field Study**
   The period of the field study is approximately 8 months. Following generally accepted protocols in the use of mailed survey instruments (Dillman 1978; Fowler Jr. 1993) and online data collection (Simsek and Veiga 2001; Stanton 1998; Stanton and Rogelberg 2001). Author will contact the sample population by mail and e-mail with a request for a meeting at their incubator facility and for their participation in the survey.
5. **Data Analysis**
   Data analysis will include the Pearson correlations, Cronbach's alpha and descriptive statistics. Pearson's correlation reflects the degree of linear relationship between two variables. It ranges from +1 to -1. A correlation of +1 means that there is a perfect positive linear relationship between variables. Cronbach's alpha is commonly used as a measure of the internal consistency or reliability of a psychometric test score for a sample of examinees. Descriptive statistics are used to describe the basic features of the data in a study. They provide simple summaries about the sample and the measures. Together with simple graphics analysis, they form the basis of virtually every quantitative analysis of data.

Significance

The result of the research will enrich the literature on business incubator topics, on issues concerning business incubation process. It will also be beneficial to the university, government and private sector in order to create a good business incubation process which aiming a good performance.

The knowledge and skills gathered during the research will also increase my expertise in the business incubator and SME's field and I believe it will beneficiary to develop Entrepreneurship and Technology Management interest group in the institution I currently serve, The School of Business and Management –Institute of Technology, Bandung (SBM-ITB). Being a faculty member within the institution will enable me to shape the minds of future leaders of Indonesia by knowledge sharing which occurs during activities I conduct within the institution.

References

Akhmad Junaidi, dkk. 1997. Kinerja Inkubator Bisnis dan Teknologi (dalam Media Informasi, Nomor: 03 tahun 1998, Badan Penelitian dan Pengembangan Koperasi dan Pengusaha Kecil)

Albert, P., & Gaynor, L. (2003). National contexts, incubator families and trends in incubation-views from four countries, The 48th ICSB Conference Proceedings, Belfast.

Campbell, C. (1989). Change agents in the new economy: Business incubators and economic development. Economic Development Review, 7(3), 56–57

Autio, E., &Klofsten, M. (1998). A comparative study of two European business incubators. Journal of Small Business Management, 36(1), 30–43.

Barrow, Colin, 2001. Incubators: A Realist's Guide to the World's New Business Accelerators, John Willey & Son, Ltd, London.

Dipta, I Wayan, 2003. "Inkubator Bisnis dan Teknologi Sebagai Wahana Pengembangan Usaha Kecil Memasuki Era Global", INFOKOP, Jakarta.

D. Patton, L. Warren, D. Bream, 2009, Elements that underpin high-tech business incubation processes, J TechnolTransf (2009) 34:621–636)

Hackett, S. M., &Dilts, D. M. (2004b). A systematic review of business incubation research. The Journal of Technology Transfer, 29(1), 55–82.

Hackett, S. M., &Dilts, D. M. (2007). Inside the Black Box of Business Incubation: Study B-Scale Assessment, model refinement and incubation outcomes. The Journal of Technology Transfer, 33: 439–471.

Hansen, M. T., Chesbrough, H. W., Nohria, N., &Sull, D. N. (2000). Networked incubators: Hothouses of the new economy. Harvard Business Review, 78(5), 74–84. September/October.

Harman, P. and Read, L. (2003), "Supporting incubation in the UK through the development of benchmarks", UKBI: International Council for Small Business, 48th World Conference, Northern Ireland, 15-18 June, p. 2.

Kajian Inkubator Bisnis dalam Rangka Pengembangan UKM, Bank Indonesia, 2006 Tim Pengembangan dan Penelitian Biro Kredit

Khavul, S., Brush, C. G., Kalish, S., & Lerner, M. (1998).Public policy and private initiative in the incubation of Israeli high technology entrepreneurial firms. Paper presented at the Babson College Frontiers of Entrepreneurship Research. Paper available at www.babson.edu/entrep/fer/papers98

Lyons, T. S. (1990). Birthing economic development: How effective are Michigan's business incubators? Center for the redevelopment of industrialised states. USA: Social Science Research Bureau, Michigan State University.

Manan, A.A.B.A and M.G.B.M. Yunos (Jan 2001). "Technology Business Incubators—A Smart Partnership. "International Workshop on Technology Business Incubators in India, Bangalore, India 1-20

Mian, S. A. (1997). Assessing and managing the university technology business incubator: an integrative framework. Journal of Business Venturing, 12, 251–285.doi:10.1016/S0883-9026(96)00063-8.

NBIA. National Business Incubation Association. (1997). Industry facts and figures, 20 E circle drive, Athens, OH 45701–3571.

Reid, S., & Garnsey, E. (1998). Incubation policy and resource provision: meeting the needs of young, innovative firms. In R. Oakey (Ed.), New technology-based firms in the 1990s, Vol. 5 (pp. 67–80). London: Paul Chapman

Rice, M. P. (2002). Co-production of business assistance in business incubators: An exploratory study. Journal of Business Venturing, 17, 163–187.doi:10.1016/S0883-9026(00)00055-0.

Statistik Usaha Kecil dan Menengah 2007-2008 Kementerian Negara Koperasidan Usaha Kecil & Menengah dan Badan Pusat Statistik

Entrepreneurial Culture and Leadership in Public and Private Institutions in Indonesia

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Abstract

In today's competitive environment institutions, including companies, are creatively finding ways in offering best values to their customers.They need to deliver their products and services in efficient and effective ways to outperform their competitors and/or to better serve their stakeholders. Institutions, either public or private, are required to be more entrepreneurial in finding new opportunities and capturing these opportunities with all risks involved in order to create added values. Thornberry models entrepreneurial practices in organizations into two areas, which are culture and leadership. This study is to investigate the practice of entrepreneurial culture and leadership in Indonesian institutions comparing between public and private institutions. Thirty (30) institutions, mostly business organizations, are investigated consisting of 19 private and 11 public institutions. The private institutions include banking and insurance companies, hospital, university, food and manufacturing companies. The public institutions include state-owned companies, university, and governmental agencies. The investigation is done using Entrepreneurial Orientation Survey (EOS) and Entrepreneurial Leadership Questionnaire (ELQ) developed by Thornberry. On entrepreneurial culture, the results are: (1) private institutions have more entrepreneurial culture than public institutions do, and (2) either public or private institutions show low score in risk-taking attitude. On entrepreneurial leadership, the results are: (1) private institutions have more entrepreneurial leadership than public institutions do, and (2) public institutions need heavily for the integrator type of entrepreneurial leaders, while private institutions show no sign of need for any specific type of entrepreneurial leaders. Top management/leadership of public institutionsneed to be more entrepreneurial by creating entrepreneurial culture in their organizations and focusing on marketplace. These integrator leaders need to remove unnecessary rules/regulations and bureaucratic procedures that inhibit employees to act entrepreneurially.

Keywords: Corporate Entrepreneurship; Intrapreneurship; Entrepreneurial Culture and Leadership; Public and Private; Indonesia

D. Higher Education Role in Triple Helix

PRODUCTION-BASED EDUCATION (PBE): THE FUTURE PERSPECTIVE OF EDUCATION ON MANUFACTURING EXCELLENT

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Abstract
Manufacturing sector plays an important role in national as well as global economy. The competitiveness of national manufacturing requires highly educated and motivated workforces as their capability are also critical to the future viability of national manufacturing sector. Consequently, a manufacturing education is needed to be constructed as one of major drivers that can play a significant role in promoting excellence for manufacturing, leveraging competitive advantage of the industries as well as for leveling up national economic in order to cope with global challenges in the years to come [1]. The practice of manufacturing education in Indonesia to some extent has been carried out separately and independently from industry. It is difficult for industry to comprehend and adapt directly to the technological advances. Therefore, it is required for manufacturing education to have a new collaboration approach with industry in order to prepare industry for innovation and for maintaining its competitive advantages. This paper will discuss the implementation of manufacturing education in one of vocational and technical higher education institutions for manufacturing in Indonesia, known as Politeknik Manufaktur (POLMAN) Bandung. The discussion gives emphasis to the way in which POLMAN Bandung carries out manufacturing education by means of a Production-Based Education (PBE) model which embraces collaboration between education and industry. Being implemented in the last two decades, PBE model has shown its quality as a promising breakthrough for integrating a 'real' industry environment with the education concept. With PBE, POLMAN Bandung has been able to establish a new definition and education paradigms within which direct involvement of all stakeholders is carried out through a number of collaborative actions linking needs to both the industrial and education systems. Moreover, PBE brings up a number of important issues of manufacturing education such as embedding entrepreneurship and innovation within its education system, providing education model as a mean to develop qualified workforces for new job environments, and promoting an integrated approach of Tri-Dharma Perguruan Tinggi (education and training, research, technology transfers and community services). PBE is one of promising models in manufacturing education as it is able to address a number of emerging challenges related to industry, academia and the society in general (including government); as well as to comprehend the implementation of knowledge transfer to maintain technological excellence in industry. Furthermore, PBE also promotes and develops competency and professionalism that can be used as a strategic framework for promoting productive teaching and active learning at Polytechnic education in general.

UNIVERSITY-INDUSTRY JOINT-RESEARCH: HOW DOES THE INDONESIAN INDUSTRY PERCEIVE IT?

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Abstract
This study aims to examine university-industry collaboration from the industry perspective. From a survey to 110 firms that have been engaged in university-industry jointresearch funded by the Indonesian government, we found various motivations in setting up a joint-research with the universities. These included gaining access to new ideas, utilizing opportunity to get involved in a relevant research, and accessing to the available research funding. A variety of benefits were enjoyed by the industry, such as gaining access to new ideas and know how from the university, improving product and process development, advancing ability to
provide better information to consumers/suppliers and making R&D activities better. However, the industry perceived that their allocated investment was not paid off as expected, and they were in doubt about the applicability or the commercialization of the research output. The findings also indicated that the researchers were less engaged to start the research from the real problem faced by the industry, but rather from a priori perception or ideas they had in mind. Some recommendations were also provided in this paper.

Keywords: university-industry collaboration, joint-research, triple-helix, developing countries, Indonesia.

1. INTRODUCTION

Oscar Handlin, a professor of history at Harvard University, as cited by Boyer (1995; p. 33), many years ago, challenged the university scholars this way:

> "A troubled universe can no longer afford the luxury of pursuits confined to an ivory tower.... Scholarship has to prove its worth not on its own terms, but by service to the nation and the world."

According to Boyer (1995), this is what the scholarship of engagement is all about. The universities should be engaged in improving the quality of life and not live in an ivory tower. The scholarship of engagement concerns with how academics relate their academic activities with people and places outside the campus and ultimately direct the work of the academy 'toward larger, more humane ends' (Van de Ven, 2007). Engaged scholarship can be defined as

> "a participative form of research for obtaining the different perspectives of key stakeholders (researchers, users, clients, sponsors, and practitioners) in studying complex problems." (Van de Ven, 2007; p. 10).

University-industry collaboration is one of the manifestations of this engagement (Perkmann and Walsh, 2008). By including the government, this collaboration is often termed as the triple helix (Benner and Sandström, 2000). In developed counties, studies on the university-industry collaboration have been conducted since 1980s (Bonaccorsi and Piccaluga, 1994; Poyago-Theotoky, 2009). The collaboration may be executed in various forms, such as academic consulting, the establishment of research parks and incubators, spin-off companies, and joint-research (see e.g., Lee, 1996; Perkmann and Walsh, 2008; Poyago-Theotoky, 2009). However, previous studies have identified various challenges to cope with in setting up and fostering the collaboration. Among them are conflicting missions, unsupportive organizational policies, and sustainability (Lee, 2000; Jacobsen et al., 2004; NCURA, 2006).
In the context of developing countries, like Indonesia, university-industry collaboration is not as well established as the one in the context of developed countries, which have a long history in the practice. In the last few years, the Indonesian Government has been allocating considerable grant to finance university-industry joint-research, to foster the scholarship of engagement. The ultimate goal of this initiative is to support a national innovation system and to strengthen national industry (Lee, 2000). Hence, understanding the joint-research activities from perception of the industry then can be considered as crucial.
However, to our best knowledge, there are no accessible reported studies to examine how the joint-research initiatives have been implemented. This study aims to examine universityindustry collaboration from the perspective of industry. The research questions addressed by this study are:
a. Why does the industry engage with university in a joint-research?

b. How does the industry perceive the joint-research?
The rest of the paper is structured as follows. Section 2 presents the literature review. Section 3 describes the research method, followed by the presentation of the findings in Section 4. The findings are discussed in Section 5. Section 6 brings this paper to end.

2 THEORETICAL FRAMEWORK

In this section, we focus our elaboration on three aspects of university-industry collaboration, and more specifically university-industry joint-research. We begin this section by presenting the concept of 'engaged scholarship' that is relevant in this study. Next, we briefly discussed the motivations and benefits of university-industry joint-research.

2.1 Engaged scholarship

The problem addressed by Oscar Handlin quoted in the beginning of the paper is persistent, still exits until nowadays, and no one knows when the problem will be resolved. One way to address it is by improving our understanding about the problem. As noted by Van de Ven (2007), scholarly work (as a representative of university) and managerial work (as a representative of industry) differ in context, process, and purpose. The differences are summarized in Table 1.

Table 1. Scholarly work vs. managerial work

	Scholarly work	*Managerial work*
Context	Committed to build generalizations and theories that often take the form of formal logical principles or rules involving causal relationships	Situated in particular problems encounter in everyday activities
Process	Involves the quest for generality in the form of "covering" laws and principles that describe the fundamental nature of things	Involves understanding of the problems and tasks that arise in particular situations and of means-ends activities that comprise their solutions
Purpose	Knowing how to see specific situations as instances of a more general case that can be used to explain how what is done works or can be understood	Knowing how to deal with the specific situations encountered in a particular case

Source: Van de Ven (2007).

A question arises. Despite these differences, can these two camps be reconciled? The introduction of the concept of the scholarship of engagement1 was intended to bring university and industry closer. As Boyer (1995; p. 33) asserted:

> "Increasingly, I'm convinced that ultimately, the scholarship of engagement means creating a special climate in which the academic and civic cultures communicate more continuously and more creatively with each other, helping to enlarge what anthropologist Clifford Geertz describes as the universe of human discourse and enriching the quality of life for all of us."

In the context of this study, university-industry joint-research "should be to create the public good while simultaneously satisfying the mission and objectives of each partner" (NCURA, 2006; p. 3). Here, the 'quality of life' is translated into 'public good'.
In the practice of the engaged scholarship, Van de Ven (2007) argued that research should be used for problem solving. The problem solving activity of the engaged scholarship process focuses on linking the research findings back to the problem observed in the practice. This involves iterative process from problem formulation, theory building, research design, and problem solving (Van de Ven, 2007). Further, engaged scholarship can be manifested in various forms depending on the research question/purpose (i.e., to describe/explain vs. To design/control) and the research perspective (i.e., extension, detached, outside vs. intension, attached, inside) (see Figure 1).

		Research question/purpose	
		To describe/explain	*To design/control*
Research perspective	*Extension Detached Outside*	Basic science with stakeholder advice	Policy/design science evaluation research for professional practice
	Intension Attached Inside	Co-produce knowledge with collaborators	Action/intervention research for a client

Figure 1. Alternative forms of the engaged scholarship (Van de Ven, 2007)

When a researcher aims to build a technological artifact, for instance, her research purpose is to design and her research perspective should be attached or high level of involvement is needed. Here, Van de Ven (2007) identified caveats of the engaged scholarship. They include: (1) the challenges of engagement, (2) being reflexive about the researcher's role in a study, (3) establishing and building relationships with stakeholders, and (4) spending time in field research sites. This argumentation indicates that, in one hand, the involvement of both parties and a good communication between them in the research is very important. This process will ensure the relevance of the research. In another hand, the rigor of the research should not be sacrificed.

To cope with the problem of imbalance between the relevance and the rigor the research, Sein et al. (2011) proposed a research method so-called action design research (ADR), which was a combination between action research (see e.g., Baburoglu and Ravn, 1992; Iivari and Venable, 2009) and design research (see e.g., Peffers et al., 2008; Iivari and Venable, 2009). The main objective of ADR was to solve the following problem in design research.

> "[The methods] value technological rigor at the cost of organizational relevance, and fail to recognize that the artifact emerges from interaction with the organizational context even when its initial design is guided by the researchers' intent." (Sein et al., 2011; p. 37).

ADR consists of four stages and seven principles. The four stages are: (a) problem formulation; (b) building, intervention, and evaluation; (c) reflection and learning; and (d) formulation of learning. The seven principles are: (1) practice-based research; (2) theoryingrained artifact; (3) reciprocal shaping; (4) mutually influential roles; (5) authentic and concurrent evaluation; (6) guided emergence; and (7) generalized outcome (Sein et al., 2011).

2.2 Motivation

Understanding the motivation of each party is very important, since successful universityindustry collaboration should support the mission of each partner. Failure in taking the different or occasionally conflicting mission of each party into consideration will lead to a failed collaboration (NCURA, 2006).

From the extant literature, we identified various motivations behind the university-industry collaboration. In one hand, from the perspective of industry, the collaboration is expected to help in providing solution for technical and design problems, developing new product and process, improving product quality, and recruiting university's graduates. In another hand, the university expects to obtain financial support for research, to access to more applied research opportunities, to open business opportunities, and to get better information to improve the curricula design (Bonaccorsi and Piccaluga, 1994; Lee, 2000; Feller et al., 2002). When we included government into the constellation, they have their own motivation. Their motivations include promoting national innovation systems and strengthening national industry (Lee, 2000).

More specifically, Bonaccorsi and Piccaluga (1994) classified the motivations of industry in a joint-research initiative into four groups: (a) getting access to scientific frontiers (such as getting access to scientific frontiers included getting access to new ideas and university expertise); (b) increasing the predictive power of science (such as opportunity for jointproject and cross-disciplinary research); (c) delegating selected development activities (such as getting access to university test bed); and (d) overcoming lack of resources (such as getting access to equipment/facilities at university). A list of industry motivations identified by Feller et al. (2002) can be mapped properly into these four groups.

2.3 Benefits

Expectation of the industry from joint-research activities spreads from knowledge generation, through knowledge transmission, to knowledge propagation (Bonaccorsi and Piccaluga, 1994). The expectation can be transformed into objective performance indicators such as number of new product, number of researchers involved, number of publication, and number of patents (Bonaccorsi and Piccaluga, 1994). However, we have to note here, that these indicators in many cases are not applicable in every context. In the context of developing countries, measuring the level of innovation using R&D spending and number of patents can be misleading (Indarti, 2010). We have to admit that these two measurements are effective but not comprehensive.

Often, the objective indicators cannot capture all the benefits and hence other subjective indicators are needed (Smith, 2004; Kleinknecht, 2002). These indicators include the perception of the firm into various aspects related to the joint-research activities, such degree of firm's involvement, relevance of research topic, and applicability of the results. In this study, we used these subjective indicators. It is often difficult for the firms to provide exact figures related to the joint-research activities (for example, number of new product and process, investment pay-off) and available objective measurements are irrelevant or not preferred by the firms (such as number of publications).

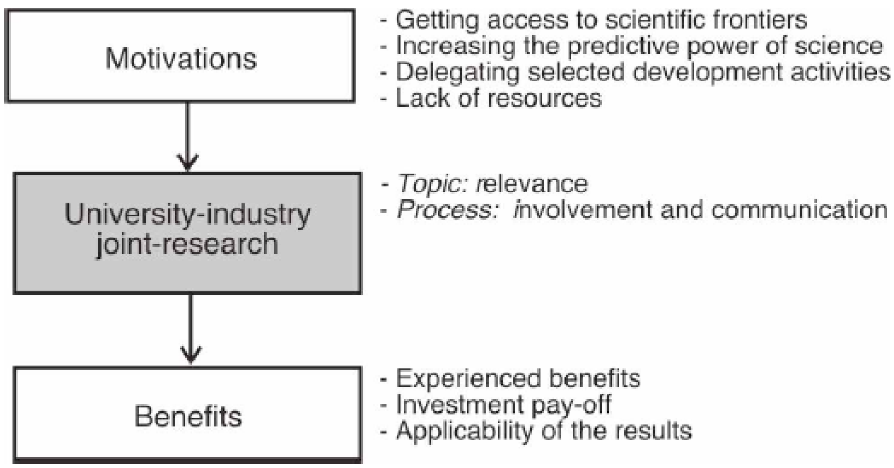

Figure 1. The conceptual framework

The aforementioned concepts were combined to provide a conceptual framework for this study (see Figure 1). In summary, the study focused on identifying motivations of the firms in partaking in the joint-research activities, their assessment on various aspects during the research process, and experienced or perceived benefits enjoyed by the firms. However, we did not pay attention to causality of the concepts.

3. RESEARCH METHOD

This study is exploratory in nature. Survey was the main data collection strategy. Based on our preliminary interviews and previous literature, a research instrument was developed. A set of items developed by Feller et al. (2002) was adopted to capture the motivation of the surveyed firms to engage in joint-research activities and to capture benefits they experienced. In addition, we developed additional items to get demographical information and other research-related activities.

Data was obtained from the pool of 110 firms that have been engaged in university-industry joint-research funded by the Indonesian government in 2009 and 20102. Unfortunately, the persons in charge of 47 firms could not be contacted since they have been retired or moved to another firm. However, among 63 firms that could be contacted, 32 were willing to take part in our survey. The 31 firms that were not willing to participate in the survey have their own motivations. Some firms perceived that the research was not conducted since they were only contacted during the research proposal preparation, while some other firms were not satisfied with the progress of the joint-research.

Among the respondents, 53% had no R&D department, while the rest (47%) had an R&D department with four employees on average. On average, the firms had 42 employees both permanent and contract ones. The firms had been being in operation for 16.4 years, with average annual revenue IDR 12.9 billion (from IDR 400 million to IDR 39 billion). Hence, we had to note here that the discrepancy among the firms was huge. The firms, on average, have been being engaged with joint-activities with university since 2.5 years ago.

4. FINDINGS

The study found that the industry has been engaged in various activities with the university. In addition the joint-research activities funded by both parties, the most popular jointactivities were training and conferences (see Table 1).

Table 1. University-industry joint-activities

Activities	*The engaged firms*	
	n	*%*
Conferences	11	34.4
Consultation and research funded by the industry	3	9.4
Building physical facilities	10	31.3
Trainings	20	62.5
Research funded by both the university and the industry	32	100.0

As regards the motivation, the study unveiled various motivations of the industry in setting up a joint-research with the university. These motivations include gaining access to new ideas, utilizing opportunity to get involved in a relevant research, accessing to the available research funding, gaining opportunity to interact with other university's partners, and the university has relevant researches to industry (Table 2).

Table 2. Motivation for participation

Motivation	*Mean ratings**
Access to new ideas	4.4
Opportunity to keep abreast of university-based research in the field	4.3
Availability of research funding	4.3
Opportunity to interact with other industries collaborating with university	3.9
Technological/research focus at university matches our interest	3.9
Opportunity to support university	3.8
Ease in-person interaction (geographic proximity)	3.8
Opportunity for cross-disciplinary research	3.7
Access to university expertise	3.7
Access to equipment and/or facilities at university	3.7
Access to university test bed facilities or prototyping capabilities	3.6
Prior connection/relationships with individuals at university	3.6
Opportunity for joint projects	3.5
Access to university students as prospective new hires	3.2
Access to specific faculty	3.1

Note: *Measured using 5-point Likert scale (1: strongly disagree; 5: strongly agree).

Various benefits were enjoyed by the industry, such as gaining access to new ideas and know how from the university, product and process improvement, improving ability to provide better information to consumers/suppliers, R&D activities improvement, and new product and process development (Table 3).

Table 3. Benefits experienced by the industry

Benefit	*Mean ratings**
Obtained access to new ideas, know-how, or technologies through university interaction	4.2
Improved a product or process	3.9
Provided customers/suppliers with improved technical information	3.8
Influenced the R&D agenda of this or another firm unit	3.7
Developed a new product/process	3.7
Licensed technology or software developed by university	3.6
Received direct technical assistance from university	3.5
Adopted university technology or research output for manufacturing or production	3.5
Reduced costs	3.3
Increased sales/profits	3.3
Used university facilities or equipment	3.2
Developed joint-research proposals or projects with other sponsors	3.2
Commercialized a product/process obtained from university	3.1
Increased interaction with other firms partnering with university	3.1
Decreased the lead-time needed for the introduction of a new product/process	2.5
Hired university student or graduate	2.5
Established a new company/joint-venture based on university technology/product	2.5

Note: *Measured using 5-point Likert scale (1: strongly disagree; 5: strongly agree).

The surveyed firms confirmed that the joint-research topic was relevant with the their competence (see Table 4 Panel A). Only 6.3% of the respondents who were in doubt about the relevance of the joint-research topic, while the rest considered as either relevant of very relevant. However, when we go further to scrutinize the involvement of the industry and the intensity of communication between the industry and the university-based researcher, we found a different picture. The degree of the firm's involvement during the research process was moderate. However, it is worth noting here that 34.4% of the respondents considered their involvement was low and even 6.3% of them were never being involved (Table 4 Panel B).

This finding was confirmed by the intensity of communication which in fact was problematic. As can be seen in Table 4 Panel C, a large percentage of the firms (34.4%) communicated with the researcher only during the research proposal making. On the other hand, the similar proportion of the respondents (31.3%) reported that they had intensive communication with the researchers.

Table 4. Relevance of the topic and the joint-research process

Item	*Percentage of respondents*					*Mean rating*
Panel A						
	Very irrelevant	*Irrelevant*	*In doubt*	*Relevant*	*Very relevant*	
Relevance of the joint-research topic with the firm's competence	0.0	0.0	6.3	78.1	9.4	4.1
Panel B						
	No at all	*Low*	*Moderate*	*High*	*Very high*	
The firm's involvement in the joint-research activities	6.3	34.4	15.6	37.5	0.0	3.1
Panel C						
	During the proposal making	*Very seldom*	*Occasionally*	*Often*	*Very often*	
Communication between the firm and the university-based researcher	34.4	15.6	12.5	31.3	0.0	2.6

In general, the industry perceived that their allocated investment was not paid off as expected, and they were in doubt about the commercialization of the research output (see Table 5 Panel A). Several motivations were identified behind these not-so-successful researches include lack of testing to make the product ready to market and no further research to improve the result or lack of sustainability.

Table 5. Impact and applicability of the results

Item	*Percentage of respondents*					*Mean rating*
Panel A						
	Severely failed	*Failed*	*In doubt*	*Successful*	*Very successful*	
Degree of the firm's investment pay-off	0.0	12.5	50.0	34.4	0.0	3.3
Panel B						
	Impossible	*Extremely difficult*	*In doubt*	*Applicable to some extent*	*Very applicable*	
Applicability of the joint-research results	6.3	9.4	37.5	6.3	40.6	3.7

The study also found that the degree of applicability of the joint-research results varied. As much as 46.9% of the respondents considered that the results were either applicable to some extent or very applicable (to be used or to be commercialized), while 37.5 of them were in doubt (see Table 5 Panel B). Even, 15.7% of the respondents assessed that the results of the joint-results were either extremely difficult or impossible to be applied or commercialized. This finding also indicated that the university-based researchers were less engaged in starting the research from the real problem, but rather from a priori perception they have already in mind.

5 DISCUSSION

5.1 Answering the research questions

The study unveiled various motivations of the industry to participate in the joint-research. The most important motivation was to gain access to new ideas. This finding was in line with Feller et al.'s (2002) study in the context of United State. This most important motivation was about getting access to scientific frontiers (Bonaccorsi and Piccaluga, 1994). Other important motivation were utilizing opportunity to keep abreast of university-based research in the field, accessing to the available research funding, and gaining opportunity to interact with other university's partners. The degree of importance of these motivations was slightly different from Feller et al.'s (2002) study. However, it is interesting to note here that the availability of research funding from the government was very attractive for the industry. This finding substantiated the fact that the willingness of the industry alone to finance the joint-research was still very low (see Table 1).

Despite the lack of communication and low degree of involvement of the firms during the research process, various benefits were still enjoyed by the industry. The most important experienced benefit was access to new ideas, know-how, or technologies through university interaction. The importance of this benefit was in concordance with Feller et al.'s study (2002). Other perceived benefits included product or process improvement, provision improved technical information to customers/suppliers and improvement of the R&D agenda. Although new product/process development was often considered as the ultimate goal set by the sponsor (i.e., the government), it was only on this fifth place. This goal has not been met yet. In this regard, the following comment from one respondent was worth noting:

> "The research outputs in the field of defense technology were difficult to be commercialized due to their limited targeted market. However, maintaining the collaboration with University A was much more important than the research output itself. We gained advantages from this collaboration."

This statement indicated that getting a commercialized or applicable research output was not always at the top list of motivations. Improving corporate image and competence building, for instance, could be the possible motivations (Bonaccorsi and Piccaluga, 1994; Santoro and Chakrabarti, 2002).

5.2 'Untold stories' and problems

It was worth noting here the potential problems emerged from this survey. During our data collection process, several problems were identified. *First*, it was about possible nonresponse bias. We found that the persons in charge of 47 (42.7%) firms cannot be contacted since they have been retired or moved to another firm. It seemed that the joint-research activities were not framed in an institutional level, but in an individual level. This created a *problem of sustainability*. Sustainability is one of concerns in fostering a fruitful collaboration (Lee, 2000).

Second, among the contactable 63 (57.3%) firms, 31 were not willing to participate in our survey. Some of them perceived that the joint-research activities were not conducted, but in fact the funding was already allocated and the research was reported that it has been completed. Some firms were only involved during the early stage of research planning to legitimate the proposal. One respondent asserted:

> "I have gone through your questionnaire. But, I am in doubt how to fill in it, since until now the research has not done yet. I was only involved in the early stage, and since then, I heard nothing from the researcher."

This problem was also confirmed by the findings of this study (see Table 4). Although, the firms perceived that topic of the joint-research was very relevant to their competence, the university-based researchers did not involve their partners from the industry adequately. This fact led to a problem of involvement. A good involvement through personal interaction is required to build trust between both parties. Trust is a critical condition in collaboration characterized by high uncertainty of results (Schartinger et al., 2002).

Third, some other contactable firms were not satisfied with the results of the research. This finding indicated a *problem of quality and relevance*. This problem may be due to the failure of the university-based researcher to identify the real problems faced by the industry. One respondent stated:

> "The equipment [produced by the research] was there. But we could not use it. After finishing the research, the researcher has never visited us again. … I just put the equipment in my workshop."

Ensuring the relevance of the research to the industry is needed to strengthen universityindustry collaboration (D'Este and Patel, 2007).

5.3 Recommendations

To cope with the identified problems, we proposed the following policy recommendations: (a) improving the scrutiny of the proposed research (e.g., by involving the partner from the industry); (b) improving the monitoring of the research process; and (c) strengthening the involvement of the industry at the institutional level, instead of being at the individual level. We can expect that these initiatives could improve the quality, relevance, and sustainability of the joint-research.

On top of that, the university-based researchers are encouraged to cross the border from knowledge-transfer to knowledge co-production perspective. The concept of 'engaged scholarship' can be applied in this context (Van de Ven, 2007). In addition, action design research (Sein et al., 2011) can help to translate the engagement into methodological level. By doing so, it is expected that the joint-research will be more fruitful; by identifying the real problems faced by the industry and generating an applicable solution, and at the same time the rigor of the research is still maintained.

In a more general perspective, failure in managing expectation often was found as one of causes of unsuccessful initiatives (Yeo, 2002). Hence, in this context of the governmentfunded research, the goal may need to be adjusted by considering alternative motivations of the triple helix actors: the industry, the university, and the government. Conflicting mission (NCURA, 2006) or institutional heterodoxy (Bjerregaard, 2010) was identified as one of scholarship (see Figure 1) proposed by Van de Ven (2007) can serve well as a starting point.

6. CONCLUSION

This paper has reported the exploratory study about the motivations of the firms in partaking in the joint-research activities, their assessment on various aspects during the research process, and the experienced benefits enjoyed by them.

The main contributions of this study were threefold. *Firstly*, it revealed the motivations of the Indonesian industry to engage in the joint-research activities. The findings then can be contested with the motivation of the university of the university-based researchers and the government. *Secondly*, the study identified potential problems related to university-industry joint-research in the context of developing countries. These problems related to sustainability of the joint-research, involvement of the industry, research quality and relevance. These problems were not prevalent in the extant literature that mainly focused on the study in the context of developed countries. *Thirdly*, a set of recommendation to cope with the problems has been provided by this study. These recommendations were expected to provide 'general prescriptions' that can be applied in the contexts with similar problems.

Like any empirical studies, this study suffered from limitations. First, response rate of this study was very low. Including more respondent may provide a more comprehensive picture. Second, the study focused only on the industry perspective. These findings have not been contested yet to the perspective of other actors (i.e., university and government). Hence, one interesting future research is to test whether or not the triple-helix actors (university, industry, and government) are 'in the same bed but with different dreams'. Third, we did not use any specific theory to explain the phenomenon under investigation. Bringing in relevant theories – such as institutional theory, actor network theory, and structuration theory – can improve our understanding about the phenomenon.

References

Baburoglu, O. N., and Ravn, I. (1992). Normative action research. *Organization Studies*, 13(1), 19-34.

Benner, M. and Sandström, U. (2000). Institutionalizing the triple helix: Research funding and norms in the academic system. *Research Policy*, 29, 291-301.

Bjerregaard, T. (2010). Industry and academia in convergence: Micro-institutional dimensions of R&D collaboration. *Technovation*, 30, 100-108.

Bonaccorsi, A., and Piccaluga, A. (1994). A theoretical framework for the evaluation of university-industry relationships. *R&D Management*, 24(3), 229-247.

Boyer, E. L. (1996). The scholarship of engagement. *Bulletin of the American Academy of Arts and Sciences*, 49(7), 18-33.

D'Este, P., and Patel, P. (2007). University–industry linkages in the UK: What are the factors underlying the variety of interactions with industry? *Research Policy*, 36, 1295-1313.

Etzkowitz, H., and Leydesdorff, L. (2000). The dynamics of innovation: From national systems and "mode 2" to a Triple Helix of university–industry–government relations. *Research Policy*, 29(2), 109-123.

Iivari, J., and Venable, J. (2009). Action research and design science research: Seemingly similar but decidedly dissimilar. *Proceedings of 17th European Conference on Information Systems*, Verona, Italy, June 8-10.

Indarti, N. (2010). The effect of knowledge stickiness and interaction on absorptive capacity. *Ph.D. Thesis*. Groningen: University of Groningen.

Jacobson, N., Butterill, D., and Goering, P. (2004). Organizational factors that influence university-based researchers' engagement in knowledge transfer activities. *Science Communication*, 25(3), 246-259.

Kleinknecht, A., Montfort, K. V., and Brouwer, E. (2002). The non-trivial choice between innovation indicators. *Economic Innovation New Technology*. 11(2), 109-121.

Lee, Y. S. (1996). 'Technology transfer' and the research university: A search for the boundaries of university-industry collaboration. *Research Policy*, 25, 843-863.

Lee, Y. S. (2000). The Sustainability of university-industry research collaboration: An empirical assessment. *Journal of Technology Transfer*, 25, 111-133.

NCURA (National Council of University Research Administrators) (2006). *Guiding Principles for University-Industry Endeavors*. USA: NCURA.

Peffers, K., Tuunanen, T., Rothenberger, M. A., and Chatterjee, S. (2008). A design science research methodology for information systems research. *Journal of Management Information Systems*, 24(3), 45-77.

Perkmann, M., and Walsh, K. (2008). Engaging the scholar: Three types of academic consulting and their impact on universities and industry. *Research Policy*, 37, 1884-1891.

Poyago-Theotoky, J. (2009). University-industry technology transfer options: Licensing or research joint venture?. *Economics Bulletin*, 29(4), 2582-2591.

Santoro, M. D., and Chakrabarti, A. K. (2002). Firm size and technology centrality in industry-university interactions. *Research Policy*, 31, 1163-1180.

Schartinger, D., Rammera, C., Fischer, M. M., and Fröhlich, J. (2002). Knowledge interactions between universities and industry in Austria: Sectoral patterns and determinants. *Research Policy*, 31, 303-328.

Sein, M. K., Henfridsson, O., Purao, S., Rossi, M., and Lindgren, R. (2011). Action Design Research. *MIS Quarterly,* 35(1), 37-56.

Smith, K. (2004). Measuring innovation. In J. Fagerberg, D. C. Mowery, and R. R. Nelson (eds). *The Oxford Handbook of Innovation* (p. 148-177). Oxford: Oxford University Press.

Van de Ven, A. H. (2007). *Engaged Scholarship: A Guide for Organizational and Social Research*. New York: Oxford University Press.

Yeo, K. T. (2002). Critical failure factors in information system projects. *International Journal of Project Management*, 20(3), 241-246.

A STUDY ON STRATEGIC UNIVERSITY-INDUSTRY COLLABORATION

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Abstracts
Many governments and universities have made efforts to push academic technologies into marketplace. When firms intend to learn by collaboration, the proxy for measuring the efficacy of academic patent application or start-up formation becomes inappropriate. It is legitimate to ask what the nature of the university-industry collaboration is and what the strategic effect of innovation capability on the choice of collaboration modes is. Using information from a mail survey, this study examines the optimal collaboration mode for conveying the firms' strategic intents to interact with universities by considering firms' innovation capabilities. We address the strategic intents and exploitative-exploratory capability gap affect the choice between licensing and R&D cooperation. Several findings emerge in our study. First, firms may collaborate with universities by taking account of 'efficiency-seeking, resource-seeking or internalization-seeking' intent. We then conjecture that internalization-seeking intent is proactive and long-term oriented, efficiency-seeking intent is passive and short-term oriented, and resource-seeking intent is amid these two. Second, firms are more likely to license in university technologies when they have more superior exploitative capability than exploratory capability. But firms are less likely to collaborate with universities when they simultaneously own exploitative capability and exploratory capability.

Keywords: University-industry collaboration, Strategic intent, Exploitative-exploratory gap, Innovation capability, University licensing, R&D cooperation

INTRODUCTION

Universities and public research organizations (referred to here as university) have long been seen as the key catalyst and engine of economic development (Powell and Owen-Smith, 1998). Starting from the passage of the Bayh-Dole Act in 1980, many governments and universities have made varying efforts to push academic technologies into marketplace, especially patenting and licensing. It is therefore legitimate to ask what the nature of the university-industry collaboration in developing technology is.

Prior studies employing data enveloped analysis conclude that most universities are inefficient in terms of research expenditures and transfer revenue. The inefficiency findings (e.g. Anderson, Daim and Lavoie, 2007; Elfenbein, 2007; Thursby and Thursby, 2002) causes us to question the role of academics and research results playing in the industrial R&D process. Universities are technology suppliers to the industry. The demand-side perspective may complement the insights on this issue of the commercialization of university technology. Stated differently, whether the firm is concerned about the transfer-in and commercialization of university research matters the market for university technologies.

Several studies use patenting and licensing to measure the effectiveness of the commercialization of university research (e.g. Agrawal and Henderson, 2002; Cohen, Nelson and Walsh, 2002; Colyvas et al., 2002; Fey and Birkinshaw, 2005; Henderson, Jaffe, and Trajitenberg, 1998; Jensen, Thursby and Thursby, 2003; Langford et al., 2007; Shane, 2002; Thursby and Thursby, 2002; Thursby, Jensen and Thursby, 2001). If licensing and patenting are the goals of commercialization of university research, the firm should be willing to bring university technologies into practical use through market exchange. However, prior studies suggest that licensing and patenting are secondary to open science[1] to convey academic research to industry. Licensing and patenting appear to be useful

[1] Merton (1973) defines open science as knowledge sharing mechanisms based on the tradition in science, i.e. the free sharing of knowledge unhindered by commercial considerations (Perkmann and Walsh, 2007)..

channels of technology transfer only in pharmaceutical industry (Cohen et al., 2002). The migration of academic research to industry depends more on the channels of open science and informal channels rather than any sort of market exchange. For instance, the commercial channels of interaction like patents, incubators and start-up are considered to be the least important in Canada (Cohen et al., 2002), UK (D'Este and Patel, 2007) and Latin America (Dutrénit and Arza, 2010). If these findings hold etic in developed and developing countries, should governments and universities invest redundantly in licensing and patenting? This issue raises our interests.

According to Mansfield's (1991, 1998) estimation, academic research advances industrial R&D about ten years in biotechnology and six to seven years in non-biotechnology. If most of academic research is at the early stage of development (Colyvas et al., 2002; Thursby and Thursby, 2004), why do firms transfer university technology in? How about the firm's ultimate goal of transfer is not the eventual commercial use of the university technologies but to leverage university technologies for strengthening their innovation capabilities? It is possible that the university-industry linkage perceived by the firm is merely an entry ticket for knowledge-access relationship. Therefore, our research question is what is the optimal channel for conveying the firm's strategic intents to interact with the university by considering the characteristics of the firm's innovation capability. More specifically, how does the collaboration mode vary according to the firm's strategic intents and how does the collaboration mode vary according to the firm's innovation capability?

University-industry collaboration is a matter of strategic choice. One of the reasons is varying channels for transferring technological knowledge from university to industry such as open science, R&D contracting and partnering. Another reason is that the level of knowledge transfer is simultaneously dependent on the type of knowledge and the access intents (Amesse and Cohendet, 2001; Fey and Birkinshaw, 2005). The other reason is that the effectiveness of knowledge application or commercialization depends on the firm's innovation capability (Bierly et al., 2009; Cohen and Levinthal, 1990; Grant and Baden-Fuller, 2004) and requirements of information processing (Carson et al., 2003; Tatikonda and Stock, 2003). This study therefore explicates the relationship among channels of collaborative modes, strategic intents, capabilities and requirements of informational processing of university-industry interaction.

This empirical study has major significance. First, most studies on university-industry collaboration do not take account of strategy management or dynamic capability. Drawing on absorptive capacity and dynamic capability view, we contribute to the studies on strategic university-industry collaboration. Second, when firms intend to learn by collaboration, the proxy for measuring the efficacy of academic research transfer such as patent application or start-up formation becomes inappropriate. Therefore, understanding of the firms' strategic intents significantly contributes to the action plans of academic technology providers and agents. Finally, there are extant studies on the effect of innovation capability on innovation. However, the analysis of the effect of innovation capability on the choice of university-industry collaboration modes is sparse. We wish to provide the differing effects on university-industry collaboration and marginally contribute to technology marketing strategy development.

In the next section, we first review prior studies and offer six hypotheses. After that,, we describe our research method and discuss our results. We close by considering the implications and limitations of our study and suggesting opportunities for future research.

THEORY AND HYPOTHESES

University Technology Transfer

The academia provides knowledge with which firms can develop new technologies and promote economic development. Technology transfer is 'the practice of transferring scientific findings from one organization to another for further development so that new products such as medicines, educational tools, electronic devices, safety equipment and health services can become available to the public' (AUTM, 2010). Academic technology transfer is a process of moving ideas from an academic laboratory into the market place that consists of several steps (Rogers, Yin and Hoffman, 2000; Thursby and Thursby, 2002). The process starts from the inventor disclosing the information about his research results to patenting and then licensing to the licensee. After the licensing agreement is executed, the university may begin earning income from the transfer.

Most literature explains the differences in performance of firms at university technology transfer from the perspective of firm heterogeneity, such as firm capabilities (e.g. Zahra and Nielsen, 2002), human resource practices, incentive structures, and human capital of top management teams. Santoro and Gopalakrishnan (2001) find that the firm's trust in universities, geographic proximity, and university technology transfer policies facilitated knowledge transfer.

Santoro and Bierly (2006) examine how the firm learns from university research centers and identify that social connectedness, technological relatedness, firm's technological absorptive capacity and trust in university are significant facilitators of knowledge transfer where knowledge tacitness or explicitness moderates the relationship.

Rahal and Rabelo (2006) find that technology uniqueness and superiority; technology development time to market; the availability of a functioning prototype; the confidentiality of the technology; and the patent strength are key factors that firms license in university technologies. Bercovitz and Feldman (2007) find firms are engaged in R&D alliances with universities when their internal R&D strategies weight more heavily toward exploratory and the development of new capabilities.

In analyses of patents assigned to MIT during the 1980 to 1996 period Nerkar and Shane (2007) find that a broader patent scope, pioneering, and moderately new patent stimulate firms to transfer in and commercialize these patents. van Wijk, Jansen and Lyles (2008) using meta-analysis techniques identify that knowledge ambiguity, absorptive capacity, organizational size, and relational capital are critical antecedents to inter-organizational knowledge transfer. Knowledge ambiguity not only makes knowledge hard for competitors to imitate, but increases the difficulty to be interpreted, assimilated, and applied to commercial ends. Prior experiences and related knowledge contribute to inter-organizational knowledge transfer. But organizational antecedents of absorptive capacity such as combinative capabilities, depth and breadth of knowledge sources are largely ignored by prior studies. Organizational size positively relates to interorganizational knowledge transfer in that organizations have more resources to devote to knowledge transfer and more diverse knowledge to enable absorption of new knowledge.

Landry et al. (2010) find that the novelty of the research is positively related to patenting and start-up formation but no significant relationship with consulting. They also find that academic network resources are significantly positively related to patenting, start-up, consulting, and informal knowledge transfer activities.

University-Industry Collaboration

Academic research transferring to the industry involves various routes. The academics simultaneously engage in commercial and non-commercial knowledge transfer activities (Landry et al., 2010). Major routes from U.S. universities to industries include informal information exchange, publications and reports, public meetings and conferences, recently hired graduates, (patent) licensing, joint research, contract research, consulting, and temporary personnel exchanges (Cohen et al., 2002). These routes involve three types of personal face-to-face contacts. The first type refers to the transfer of intellectual property such as licensing, patenting and commercialization in which face-to-face contacts is relatively low. Here, legal use rather than relationship building is the focus. The second is mobility that includes academic entrepreneurship and human resource transfer. The mobility type has intermediate face-to-face contacts. The third is relationship including research partnerships and research services. Face-to-face contacts in this type are high where teams from the academics and the firm work together on specific projects and jointly produce certain outputs (Perkmann and Walsh, 2007).

In this study, we consider licensing, joint research and contract research as major collaboration modes. There are a couple of rationales. First, knowledge transfer works better when a mixture of commercial and non-commercial knowledge transfer channels is adopted. Specifically, the channels involving joint learning and knowledge co-production are optimal to drive the firm's innovation activities and to benefit the academic research career (Landry et al., 2010). Moreover, consulting does not reflect formal institutional links because most of the time the payment of consulting is paid to the consultant rather than to the university (Cohen et al., 2002; Perkmann and Walsh, 2008a). Furthermore, the boundary between contract research and joint research is blurred in practice (Bekkers and Bodas Freitas, 2008; Dutrénit and Arza, 2010; Eom and Lee, 2009).

We name contract research and joint research as cooperation R&D in this study. Licensing refers to the transfer of university-generating intellectual property such as patents and copyrights to the firm against a fee (Perkmann and Walsh, 2008a). The transfer of intellectual property involves less tacit knowledge transfer and less personal face-to-face interaction (Schartinger et al., 2002). For the majority of university licensing, the licensing is supplemented by consulting when the technology is embryonic (Jensen and Thursby, 2001). R&D cooperation including contract research and joint research is highly personal face-to-face interaction required throughout the period of the interaction agreement (Arza, 2010; Dutrénit and Arza, 2010; Schartinger et al., 2002). Universities and the firms provide complementary knowledge resources over the period of R&D cooperation.

Strategic Intent

What factors affect the propensity of firms to draw from academic research? Most studies analyzing the relationship between collaboration modes and strategic intents reveal inconsistent findings. Perkmann and Walsh (2008a) find that licensing is suitable for both intents. On one hand, university licensing technologies often enables firms to access to new technologies because most university licensing involves early-stage technologies and needs further development (Thursby and Thursby, 2004). On the other hands, licensee firms aim at the licensed objects; namely, the intent is short-term oriented. They also find that contract research is suitable for problems known to the firm, but joint research is suitable for accessing the new knowledge. Sometime, joint research may supplement the licensing deals to get into industrial use. However, Cohen et al. (2002) find that contract research is important for firms to initiate new R&D projects but licensing and joint research are important to complete existing projects.

When do firms cooperate with universities where the collaboration is short-term oriented? Most firms are more effective in applied research. Firms may address particular needs or problems through contract research or joint research with universities. R&D cooperation can be supplemented by a licensing deal to facilitate the licensed technology commercialization. At times, R&D cooperation works when the technology involves a platform development or process improvement (Perkmann and Santoro, 2008a; Santoro and Chakrabarti, 2002). Firms may approach for university licensing when the solutions to their problems are ready-to-use but protected by universities (Perkmann and Walsh, 2008a, 2008b; Colyvas et al., 2002).

Firms may concentrate on learning by cooperating with universities rather than licensing for the following reasons. Firstly, it is possible that firms focus on strategically access to advanced knowledge rather than acquiring the technology (Grant and Baden-Fuller, 2004). R&D cooperation tying firms with universities promotes firms to access advanced technologies by a formal and informal interaction during a protracted period of time. Secondly, most of embryonic technologies are uncodified, complex, and causally ambiguous that requires considerably further development. R&D cooperation results in close interaction and knowledge co-production (Jensen and Thursby, 2001). Finally, licensing is acquiring the use of university technology legally for a payment. Although Perkmann and Walsh (2008b) propose that licensing in university-generating technologies and engaging the inventors with consulting or collaborative research may meet firms' needs to acquire advanced technology (Perkmann and Walsh, 2008b), we argue that the long-tern time horizon occurs through R&D cooperation rather than licensing. Hence, we hypothesize that:

Hypothesis 1. Firms are more likely to license university technologies when their primary intent is short-term oriented.

Hypothesis 2. Firms are more likely to employ R&D cooperation with universities when their primary intent is long-term oriented.

Exploitative-Exploratory Capability Gap

Ambidexterity refers to an organization's ability to do two different things at the same time (Gibson and Birkinshaw, 2004). Past research has confirmed that ambidextrous organizations are more innovative because they are capable of exploiting their existing competencies while exploring new opportunities (March, 1991; O'Reilly & Tushman, 2008). Exploiting existing competencies is an orientation to the short-term whereas exploration has a more future-based, or long-term focus (He & Wong, 2004). Exploitation activities may be directed toward gaining efficiency while exploration activities promote flexibility in the organization. However, the literature does not specify the precise amount of exploitation or exploration a firm needs. Most of prior studies posit that a balance between rather than choosing exploration and exploitation is a strategic issue (Lavie and Rosenkopf, 2006; Rothaermel and Deeds, 2004).

OECD (1991) defines innovation as an iterative process initiated by the perception of a new product-market opportunity for a technology-based invention which leads to development, production, and marketing tasks striving for the commercial success. Innovation capability refers to the firm's ability to develop new products-markets through aligning strategic innovation intents with innovation behaviors and processes (Wang and Ahmed, 2007). March (1991) suggests that exploration is variation-seeking, risk-taking and experimentation oriented whereas exploitation is variety-reducing and efficiency oriented. Exploitation of existing capabilities is needed to explore new capabilities and exploration of new capabilities enhances a firm's existing knowledge base (Katila and Ahuja, 2002). Atuahene-Gima (2005) provides evidences that exploitation is positively related to incremental innovation performance but negatively related to radical innovation performance, while exploration is positively related to radical innovation performance but negatively related to incremental innovation performance. Hence, innovation capability can be divided into exploratory capability versus exploitative capability.

Exploratory capability versus exploitative capability is a blend of dynamic capability (Eisenhardt and Martin, 2000). Exploratory capability relates to the creative processes of searching, discovering, and experimenting for new knowledge or innovation, whereas exploitative capability relates to the refinement and extension of existing knowledge or innovation (He and Wong, 2004; March, 1991). Exploratory capability produces radical innovations by offering new customer value and exploitative capability increases incremental innovations by improving products to satisfy the needs of existing customers (Atuahene-Gima, 2005).

In our context, exploitative capability refers to the application of university technology to refine existing products and technologies and exploratory capability refers to the application of university technology to produce new products and technologies (Bierly et al., 2009). A higher level of exploitative capability helps to capitalize on firms' existing knowledge and market to commercialize the licensed technologies (Rothaermel and Deeds, 2004). Firms that have a greater level of exploitative capability are more familiar with the potential technological application than universities. Such firms usually decide how to apply university technologies before negotiating the license deal with universities. Therefore, firms may simply want to use university technologies legally. Meanwhile, such firms will not collaborate with universities because universities cannot provide the downstream and complementary resources for commercializing the licensed university technologies (Rothaermel and Deeds, 2004). Therefore, R&D cooperation will not be the alternatives of technology development decisions when firms have a greater level of exploitative capability than exploration capability.

Hypotheses 3. Firms are more likely to license university technologies when exploitative-exploratory capability gap is positive.

Hypotheses 4. Firms are less likely to employ R&D cooperation with universities when exploitative-exploratory capability gap is positive.

The revolution of innovation capability is a blend of dynamic absorptive capacities (Eisenhardt and Martin, 2000). The development of exploitative capability depends on prior exploration (March, 1991). Successful exploration results in exploitation (Rothaermel and Deeds, 2004). Firms leverage existing exploitative capability to serve new type of customers or to add new capability such as NPD or intellectual property (Atuahene-Gima, 2005; Cao, Gedajlovic and Zhang, 2009). For instance, Atuahene-Gima (2005) shows that exploratory capability will be more likely to succeed in developing radical innovations by recombining this knowledge with some level of exploitative capability and vice versa. Cao et al. (2009) provide evidence that firms combining exploitative innovation and exploratory innovation have greater access to external resources through developing complementary resources.

Innovation capability is also critical to capability reconfiguration (Atuahene-Gima, 2005; Danneels, 2002; Wang and Ahmed, 2007). Most firms are more capable at exploitation than exploration (March, 1991; Rothaermel and Deeds, 2004). A higher level of exploitative capability enables the firm to have more understanding of existing capabilities and thus initiates capability reconfiguration once needed (Atuahene-Gima, 2005; Cao et al., 2009; Katila and Ahuja, 2002). Innovation capability leverage improves the firm's performance because firms are adept at reconfiguring existing capabilities to add new capabilities. Firms that have possessed more superior exploitative capability than exploratory capability for a long time could be trapped by their own capabilities (Rothaermel and Deeds, 2004). Capability reconfiguration may dampen the rigidity. When firms simultaneously pursue exploratory and exploitative capabilities and commit more resources in ambidextrous innovation, their innovativeness will be higher than that firms pursue pure exploitation or exploration (Cao et al., 2009; Danneels, 2002). As such, firms have accumulated more internal innovation capabilities and have more options to interact with external knowledge sources.

Here, we expect that innovative firms are willing to proceed capability reconfiguration by interacting with universities. On the one hand, firms may license university technologies but have no concrete ideas about the eventual application. For instance, some firms in the biotechnology are motivated to license by a desire to acquire basic knowledge (Rothaermel and Deeds, 2004). The interaction between exploitative capability and exploratory capability leads to developing new technological opportunities. One the other hand, the engagement in R&D cooperation with university research may extend the firms' exploitative capability to a new field or bring about innovation that is beyond expectation. Hence, we hypothesize that:

Hypothesis 5. Firms are more likely to license university technologies for the long-term oriented intent when exploitative-exploratory capability gap is positive.

Hypothesis 6. Firms are more likely to employ R&D cooperation with universities for the long-term oriented intent when exploitative-exploratory capability gap is positive.

METHOD

Sample

We conducted a survey to collect data for the study. This survey will use a cross-sectional methodology to maximize the variation in the variables and increase the generalizability of the findings. A self-collected name list of 2429 firms is used for sampling. The list contained firms that transferred technology funded by National Science Committee of Taiwan, firms that got subsidy from Technology Development Program (TDP) of Ministry of Economic Affairs (MOEA), and public firms. We used 11 out of 145 firms that responded at the first-stage study for the pretest. These firms were contacted by email with the cover letter and questionnaire. The cover letter explained the purpose as importance of the survey and highlighted a nondisclosure principle that the responses would be treated confidentially. We offered to share the results in summary form if the informants so desired. A follow-up questionnaire was mailed one week later. The final survey was sent out to 500 firms and thus comprised 645 firms. Of these 645 firms, 4 firms did not have the experiences in university-industry collaboration. Finally, the survey generated 91 usable questionnaires for an effective response rate of 14.1%.

Measures

In this study, the constructs of strategic intents, technology uncertainty, relational capability, and innovation capability were operationalized using a multiple measures methodology. The actual measures were derived from the prior literature.

Collaboration modes

The dependent variable refers to the extent to which a firm has engaged in university licensing or R&D cooperation. For each type of channel, the respondents were asked how they had engaged in the consulting, licensing, joint research or contract research (Bekkers and Bodas Freitas, 2008; Perkmann & Walsh, 2008a).This item is a multiple choice question because the firm may simultaneously employ licensing coupled and joint research or contract research. Licensing was coded as a categorical variable where a "1" represented the firm involves licensing from the university, otherwise 0. R&D cooperation was coded as a categorical variable where a "1" represented the firm involves contract research or joint research with the university, otherwise "0".

Strategic intent

Three factors were extracted from the eleven items where eigenvalue was over 1, explaining 69% of total variance. The first factor was labeled as internalization-seeking intent that is firms' aim at internalization. The second and third factors were labeled efficiency-seeking intent and resource-seeking intent, respectively (see Table 1).

- Efficiency-seeking intent (Cronbach's α=0.78)
  - ✓ Access to licensed research findings or prototype (Cohen et al., 2002; Santoro and Chakrabarti, 2002)
  - ✓ Obtain advanced knowledge (Santoro and Chakrabarti, 2002)
  - ✓ Reduce internal R&D costs (Leiponen and Helfat, 2010)
  - ✓ Expand product assortment
  - ✓ Accumulate R&D experience
- Efficient-seeking intent (Cronbach's α=0.91)
  - ✓ Reduce use of materials (Leiponen and Helfat, 2010)
  - ✓ Increase yield rate (Leiponen and Helfat, 2010)
  - ✓ Replace outdated products (Leiponen and Helfat, 2010)
- Resource-seeking intent (Cronbach's α=0.74)
  - ✓ Use equipment and facilities unavailable internally (Cohen et al., 2002; Santoro and Chakrabarti, 2002)
  - ✓ Access key materials
  - ✓ Facilitate technology commercialization (Link et al., 2006)

Exploitative-Exploratory capability

Innovation can be characterized by exploitation or exploration. He and Wong (2004) argue that exploration versus exploitation should be used with reference to a firm's *ex-ante* strategic innovation objectives, whereas the radical versus incremental innovation is often used in an *ex-post* outcome measure. Following He and Wong's position, we regarded exploratory innovation and exploitative innovation as a firm's *ex-ante* strategic objectives in pursuing innovation and as two distinct dimensions of innovation (He and Wang, 2004). Items of exploratory capability measures how frequent technological innovation aimed at entering new product-market domains, and items of exploitative capability measures how frequent technological innovation aimed at improving existing product-market positions (Bierly et al., 2009; He and Wong, 2004).

Patent

Appropriability is a major concern for firms to choose the collaboration modes (Fey and Birkinshaw, 2005). Patent was coded as a categorical variable where a "1" represented the firm involves patented technology collaborating with the university, otherwise "0".

Collaboration experience

Collaboration experience was coded as a categorical variable where a "1" represented the firm has experiences in collaboration with from universities, otherwise "0". If there is a level of experience in external, industry-oriented knowledge interactions, organizational barriers to knowledge interactions are likely to be less important. Moreover, previous collaboration experiences will enhance interorganizational cooperation capability and thus increase the probability of future collaboration. (Schartinger et al., 2002).

Industrial sector

The intensity of use of different forms of interaction is sector, field and/or technology specific (Bekkers and Bodas Freitas, 2008; Cohen et al., 2002). Firms in certain industries frequently work with universities in transferring and applying external knowledge (Bierly et al., 2009; Santoro and Chakrabarti, 2002). For instance, firms in mechanical engineering or software development prefer contract research and consulting. Licensing is predominantly used in pharmaceuticals and biotechnology (Cohen et al., 2002).

Santoro and Chakrabarti (2002) find that high-tech firms (e.g. biotechnology, microcomputers, semiconductors, electronics, pharmaceuticals, optical equipment, medical laboratories, and research and development services) are positively associated with technology transfer and cooperative research, while resource-intensive firms (e.g. lumber and paper products, petroleum, and mining) are positively associated with knowledge transfer and support relationships. Schartinger et al. (2002) suggest that science-based industries heavily rely on new scientific knowledge and should show more intense interactions with universities. They find that R&D intensive manufacturing industries tend to use research cooperation more intensively and service industries rest more on personnel mobility and training related interactions.

In our study, industrial sector was collected via the survey. We categorized the industry sectors into three groups – ICT, biotech, and the others. The rationales for the three groups are as follows. Taiwan government has invested more infrastructure resources in ICT and biotechnology industries. Infrastructures and market opportunities might affect the external knowledge transfer and commercialization. According to 2007 Biotechnology industry annual report, Taiwan's biotech industry consists of pharmaceuticals, medical equipments, food, agriculture, chemistry, medical service, environmental preservation, etc.

Firm Size

Firm size is recognized as a key variable affecting organizational learning (Tsang, 2002). In terms of organizational knowledge transfer, effects of firm size on the extent of knowledge transferred are mixed. Most studies find that larger firms are more likely to use university research for suggesting new R&D projects and the completion of existing projects (e.g. Cohen et al., 2002; Santoro and Chakrabarti, 2002). For instance, Santoro and Chakrabarti (2002) find that large firms have higher intensity of knowledge exchange and research funding relationships for strengthening skills, knowledge, and gaining access to university facilities for non-core technologies and lower intensity technology transfer and cooperative research relationships in non-core technological areas. Bekkers and Bodas Freitas (2008) find that small firms are less inclined to use consulting, collaborative and contract research, and licensing is not associated with firm size. Conversely, small firms have lower intensity of knowledge exchange and research funding relationships for strengthening skills, knowledge, and gaining access to university facilities for non-core technologies and higher intensity technology transfer and cooperative research relationships in non-core technological areas. However, other studies have found non-significant (e.g. Bierly et al., 2009; Tsang, 2002) or negative (e.g. Makino and Delios, 1996) effects of firm size on the extent of knowledge transferred. Since van Wijk et al. (2008) in their meta analysis find firm size has been suggested to positively affect organizational knowledge transfer, we here expect it has a positive effect on initiation intent.

Following the small and medium administration's classification, firm size was measured by the number range of employees within the firm and paid-in capital, and collected via the survey. SME was coded as a categorical variable where a "1" represented small firms, those having < 200 employees and paid-in capital < NT$ 80 million, otherwise "0".

Analysis techniques

Item reliability (composite reliability) of constructs was assessed by examining loadings. When the loading exceeds the threshold of 0.7, the indicator is accepted. Alternatively, when indicators with very low loadings attenuate and bias the estimates of the parameters linking the constructs, the indicators will be dropped (Nunnally, 1978).

Convergent validity was assessed by the magnitude of the factor loading of each manifest indicator on its proposed construct. Researchers using explanatory factor analysis generally report the internal consistency measure developed by Fornell and Larcker (1981), which is similar to Cronbach's alpha. Nunnally (1978) suggests that 0.7 as a benchmark for 'modest' reliability was applicable in the early stages of research.

A binary logistic regression was undertaken to assess the effect of the variables on the probability of the dichotomous collaboration modes, using the statistical software package SPSS 12. This logit model allowed us to quantify the collaboration mode associated with various individual explanatory variables. The significance level of model chi-square helps to predict the collaboration mode odds provided by the explanatory variables and that of Hosmer-Lemeshow chi-square helps to assess the goodness of fit. Nagelkerke R-square helps to evaluate the prediction accuracy of the model estimation (Wang and Kuo, 2004).

The regression coefficients were able to be converted to odds ratios. The P value was calculated based on the Wald test statistic with chi-square distribution with 1 degree of freedom. A positive regression coefficient on an independent variable indicates that higher values increase the likelihood that a company will employ a relational exchange strategy. Negative coefficients indicate a reduced likelihood of a relational choice and so favor a discrete choice. The classification results compare the number of cases correctly and incorrectly classified to the number of cases that we would expect to correctly and incorrectly classify. The proportion expected to be correctly classified was based on the most conservative criterion (maximum group), although with an approximately even number of cases in both groups this choice of criterion makes little real difference.

Due to the single informant in each questionnaire, we conducted two preliminary analyses to check common method bias. First, we used two different sources to collect the number of capital. Because all firms register their number of capital at the government, we compared the interval of capital indicated by the respondent with that of the government to assess the inter-rater reliability for the firm size. The number of capital is confirmed.

Second, we employed Harman's one factor model. The results of this analysis showed our main effect variables generates 8 factors, each with eigenvalues greater than 1.0, accounting for 73.83% of the total variance. The percentage of variance explained of the first factor addresses 40.82%. Since no single factors dominate the factor structure, the common method bias should not be a threat in this study (Podsakoff and Organ, 1986). Second, we examined the early versus late response bias in terms of paid-in capital. No statistically significant difference emerges from the student test, suggesting that response bias seems not to be a potential problem (Amstrong and Overton, 1977).

RESULTS

Descriptive statistics

Table 2 provides the item-averaged descriptive statistics and the reliability of perceptual variables. Fifty-six percent (56%) of the university technology in our sample has been transferred through licensing, seventy-eight percent (78%) of the sample through contract research or joint research. Fifty-four percent (54%) of the sample is related to patent and fifty-eight (58%) of the firms have collaboration experiences with universities. Twenty-one percent (21%) of the technology is transferred to small and medium enterprises (SMEs). The resulting sample is most represented by the electronics manufacturing industry (ICT) (40%), followed by the biotechnology, food, and chemicals industry (33%), and the machinery, metal, and construction industry (27%).

Table 3 presents the Pearson correlation matrix between the variables for the samples of sourced-in technology from universities. The highest correlation coefficient is between ICT industry and Biotech industry (r= - 0.57). The correlation between efficiency-seeking intent and exploitative-exploratory capability combination is 0.52, suggesting that the greater level of firms' exploitative and exploratory capabilities makes them more focused on short-term and efficiency-seeking intents when they interact with universities. The strength and direction of predictors the correlation looks reasonable.

Moreover, linear regression is used to assess multicollinearity between the independent variables. All the variance inflation factors (VIF) in Table 4 are 1.81 or less, implying that there is no strong linear relationship between variables.

Logit results

Table 4 reports the logit results. Model a and model b are significant and Hosmer-Lemeshow chi_squared are insignificant, suggesting both models fit well. These equations correctly classified at least 71% of firms that use the mode to collaborate with the university.

Based on the strategic intents, we expects that firms are more likely to license university technologies when their primary intent is short-term oriented and that firms are more likely to employ R&D cooperation with universities when their primary intent is long-term oriented. Model a shows that firms are **less** likely to license university technologies when their primary intent is internalization-seeking or resource-seeking. The relationship between efficiency-seeking and the choice of licensing is not significant, although the sign of the coefficient of efficiency-seeking is positive and consistent with the predicted direction. All the coefficients of the three intents of Model b become significant, suggesting that firms are more likely to employ R&D cooperation with universities whatever their primary intent is internalization-seeking, resource-seeking, or efficiency-seeking. Remember that we drew the three intents from factor analysis. We may place these three intents at a continuum of time horizon from short–term to long-term where the efficiency-seeking and internalization-seeking intents at the extreme ends and the resource-seeking intent is in the middle. The finding is consistent with Cohen et al.'s (2002) and Cassiman et al.'s (2010) work. Hypotheses 1 and 2 are supported.

Hypothesis 3 expects that firms are more likely to employ university licensing when exploitative-exploratory capability gap is positive, But Hypothesis 4 expects that firms are less likely to employ R&D cooperation with universities when exploitative-exploratory capability gap is positive. The effect of exploitative-exploratory capability gap is negative and significant on the choice of licensing, supporting Hypothesis 3. The effect of exploitative-exploratory capability gap is negative but insignificant. Although the direction meets expectation, Hypothesis 4 is not supported. The interaction of internalization-seeking intent and exploitative-exploratory capability gap is significant in model a, but not significant in model b. Neither directions in model a and model b meet our expectation. Hypotheses 5 and 6 are not supported.

DISCUSSION AND CONCLUSION

This study examines the impact of both the strategic intents and innovation capability of Taiwanese firms on the choice of university-industry collaboration mode. Three hypotheses are supported. The implications of the analyses are below.

Theoretical Implications

First, our study suggests that firms collaborate with universities by taking account of efficiency-seeking, resource-seeking, or internalization-seeking intents. However, firms tend to cooperate not to license when they aim at seeking resources from universities or at internalizing university knowledge. Our evidence suggests that university-licensing technologies are not suitable for augmenting firms' absorptive capacity and not for engaging knowledge development when firms possess a certain level of innovation capability. Firms might use open-science channels or R&D cooperation to access to new technology rather than licensing. Obviously, this evidence is bad news for university licensing officers, but good news for university-industry promotion officers.

The efficiency-seeking intent is that firms aim to reduce some operating or development costs or to seek technological advice for operation-related problems. The efficiency-seeking intent matters for firms to collaborate with universities. However, such intent is not one of the major intents for firms deciding to license from universities. These findings are inconsistent with Perkmann and Walsh's (2008a) arguments. One possibility for the efficiency-seeking intent that has no significant impact on the choice of licensing is most of the university technologies do not fit the industrial needs.

Moreover, firms tend not to license university-generating technologies when they aim at seeking universities' resources. The negative sign of the resource-seeking intent on the choice of licensing makes us to posit that the time-frame of resource-seeking intents for firms is different from that of efficiency-seeking intents. As one of the items of resource-seeking intent in our study is that firms believe that the collaboration promotes technology commercialization, we conjecture that internalization-seeking intent is proactive and long-term oriented, efficiency-seeking intent is passive and short-term oriented, and resource-seeking intent is amid these two. However, this conjecture needs to test in the future.

Second, our results demonstrate that firms are more likely to license in university technologies when they have more superior exploitative capability than exploratory capability. Firms are less likely to collaborate with universities when they simultaneously own exploitative capability and exploratory capability. These evidences suggest that a higher level of exploitative capability enables firms to commercialize or apply the licensed technologies by satisfying the needs of existing customers or improving process innovation. Our suggestion echoes Lichtenthaler's (2009) argument. Lichtenthaler (2009) states that technological and market knowledge are two key components of prior knowledge and are critical to transform the newly assimilated knowledge. Firms need more exploitative capability to apply university technologies successfully. However, firms do not ally with universities when firms have a certain level of exploitative and exploratory capabilities. It is possible that firms will choose to ally with industrial firms or innovate in-house rather than cooperating with universities. The other possibility is that licensing and R&D cooperation may occur at the different stage of technology. According to Mansfield (1991, 1998), most of university technologies advance industrial R&D about six to ten years. At the early stage of technology firms choose to ally universities for exploring new technological opportunities (Rothaermel and Deeds, 2004). However, at the late stage of technologies firms choose to directly license and then apply them.

Finally, innovation capability reconfiguration can strengthen or reactivate firms' competitive advantages. However, our results suggest that university licensing and R&D cooperation with universities are not the major routes for firms to reconfigure innovation capability, especially when firms simultaneously own exploitative capability and exploratory capability. Personnel mobility or allying with other industrial firms paves the way for capability reconfiguration. Our finding is somewhat inconsistent with Cao et al.'s (2009) evidence. They find that firms combining these two capabilities have greater access to external resources through developing complementary resources.

Managerial Implications

Our study provides a couple of implications for university technology marketing strategies. First, we find that patenting is negatively associated with the use of university licensing and R&D cooperation, echoing that policies encouraging universities to patent and license might be misaligned with the diverse nature of the university-industry interaction (Agrawal and Henderson, 2002). Given the embryonic nature of university-protected technologies, most protected technologies carry limited potential for commercialization. These technologies, specifically patents, cannot block competitors' entry or attack competitor's technology portfolios. Moreover, firms need to possess patent pools and broad scope of patents to compete. However, universities do not provide or do not know how to pack existing university-protected technologies for marketing. These may be why there exist low links between licensing and firms' strategic intents.

Another issue in university-industry interaction is that there exists a lag between firms' technology bases and university patenting. Firms are willing to interact with universities for accessing advanced knowledge, using university resources and reducing their technology gap. Such collaboration creates awareness about university-protected technologies, thereby increasing the possibility of licensing university technologies. Finding out the potentials firms to license in university-protected technologies is one of important responsibilities of university licensing officers. The brokerage of university research faculty and the potential firms is always challenging to these officers. Officers may interact with such collaborative firms more frequently for understanding industrial needs and consequently increase the possibility of getting university technology into practice. Furthermore, connecting postgraduates helps university licensing officers to understand industrial needs. Surveying those firms where postgraduates are hired may provide insights for university research and then generate research results that are in need by firms.

Finally, firms collaborate with universities by taking account of efficiency-seeking, resource-seeking, and internalization-seeking intents. However, firms tend not to license university technologies when they aim at using university resources or at internalizing advanced knowledge. This evidence suggests that the university incubator officers may find incubating candidates from the latter firms rather than the former ones.

Limitations and Outlook

A couple of limitations and future research are worth mentioning. One of limitations of collaboration modes are the possibilities of the multiple use of licensing and R&D cooperation. Some firms may license university valuable technologies and conduct subsequent research projects with universities. Limited by the sample size, we have difficulties in splitting the samples into licensing only, R&D cooperation only, and licensing coupled with R&D cooperation. To cite our findings should be cautious about it. Future studies may extend to more collaboration modes.

Another limitation in our study is that we do not take account of consulting and start-ups. Certainly, start-ups bring university technologies out of ivory towers but do not play a dominant role in university technology commercialization (Meyer, 2006). Most of consulting is viewed as an informal collaboration mode because consulting does not generate income for university. Rather, consulting may be coupled with training programs or licensing. Hence, it is difficult to clear the impact of firms' innovation on consulting.

An additional limitation of this study is related to licensing. In this study, we neither distinguish between patent pools and single patents, nor consider the issues of cross-licensing. Perhaps this is one of the reasons that the relationship between the internalization -seeking intent and the choice of licensing is not significant. Hence, additional research in this area might be fruitful.

It is pity that our results clearly do not support the argument of the relationship between innovation capability reconfiguration and collaboration modes. A longitudinal study that examines the capability reconfiguration before and after interacting with universities would be an important and interesting area to further study. A dyad analysis of one aimed at industry researchers and one at university researchers may find the nature of innovation capability reconfiguration.

Finally, we did not control social capital, university and inventor's reputation, and interorganizational relational capability. Using a set of ten norms proposed by Macneil to measure relational capability may reach a different profile of university-industry collaboration.

REFERENCES

Agrawal, A., Henderson, R. 2002. Putting patents in context exploring knowledge transfer from MIT. Management Science 48 (1), 44-60.

Amesse, F., Cohendet, P. 2001. Technology transfer revisited from the perspective of the knowledge-based economy. Research Policy 30 (9), 1459-1478.
Anderson, T.R., Daim, T.U., Lavoie, F.F. 2007. Measuring the efficiency of university technology transfer. Technovation 27 (5), 306-318.
Armstron, S., Overton, T. 1977. Estimating non-response bias in mail surveys. Journal of Marketing Research 14 (3), 396-402.
Arza, V. 2010. Channels, benefits and risks of public–private interactions for knowledge transfer: conceptual framework inspired by Latin America. Science and Public Policy 37 (7), 473-484.
Atuahene-Gima, K. 2005. Resolving the capability–rigidity paradox in new product innovation. Journal of Marketing 69 (4), 61–83.
AUTM, 2010. About Technology Transfer. http://www.autm.net/Tech_Transfer.htm accessed on 11/20/2010.
Bekkers, R., Bodas Freitas, I.M. 2008. Analyzing knowledge transfer channels between universities and industry: to what degree do sectors also matter? Research Policy 37 (10), 1837-1853.
Bercovitz J., Feldman, M.P. 2007. Fishing upstream Firm innovation strategy and university research alliances. Research Policy 36 (7), 930-948.
Bierly, P.E., Damanpour, F., Santoro, M.D. 2009. The application of external knowledge: organizational conditions for exploration and exploitation. Journal of Management Studies 46 (3), 481-509.
Cao, Q., Gedajlovic, E., Zhang, H. 2009. Unpacking organizational ambidexterity: dimensions, contingencies, and synergistic effects. Organization Science 20 (4), 781-796.
Carson, S.J., Madhok, A., Varman, R., John, G. 2003. Information processing moderators of the effectiveness of trust-based governance in interfirm R&D collabortion. Organization Science 14 (1), 45-56.
Cassiman, B., Di Guardo, M.C., Valentini, G. 2010. Organizing links with science: cooperate or contract? A project-level analysis. Research Policy 39 (7), 882-892.
Cohen, W.M., Levinthal, D.A. 1990. Absorptive capacity: a new perspective on learning and innovation. Administrative Science Quarterly 35 (1), 128-152.
Cohen, W.M., Nelson, R.R., Walsh, J.P. 2002. Links and impacts: the influence of public research on industrial R&D. Management Science 48 (1), 1-23.
Colyvas, J., Crow, M., Gelijns, A., Mazzoleni, R., Nelson, R.R., Rosengerg, N., Sampat, B.N. 2002. How do university inventions get into practice. Management Science 48 (1), 61-72.
D'Este, P., Patel, P. 2007. University–industry linkages in the UK: what are the factors underlying the variety of interactions with industry? Research Policy 36 (9), 1295-1313.
Danneels, E. 2002. The dynamics of product innovation and firm competences. Strategic Management Journal 23, 1095-1121
Dutrénit, G., Arza, V. 2010. Channels and benefits of interactions between public research organizations and industry: comparing four Latin American countries. Science and Public Policy 37 (7), 541-553.
Eisenhardt, K., Martin, J. 2000. Dynamic capabilities: what are they? Strategic Management Journal 21 (10-11), 1105-1121.
Elfenbein, D.W. 2007. Publications, patents, and the market for academic technology. Journal of Economic Behavior and Organization 63 (4), 688-715.
Eom, B., Lee, K. 2009. Modes of knowledge transfer from PROS and firm performance: the case of Korea. Seoul Journal of Economics 22(4), 449-428.
Fey, C.F., Birkinshaw, J. 2005. External sources of knowledge, governance mode, and R&D performance. Journal of Management 31 (4), 597-621.
Fornell, C., Larcker, D.F. 1981. Evaluating structural equation models with unobservable variables and measurement error. Journal of Marketing Research 18 (1), 39-50.
Gibson, C. B., Birkinshaw, J. 2004. The antecedents, consequences, and mediating: role of organizational ambidexterity. Academy of Management Journal 47 (2), 209-226.
Grant, R.M., Baden-Fuller, C. 2004. A knowledge accessing theory of strategic alliance. Journal of Management Studies 41 (1), 61-84.
He, Z.L., Wong, P. 2004. Exploration vs. exploitation: an empirical test of the ambidexterity hypothesis. Organization Science 15 (4), 481-494.
Henderson, R., Jaffe, A.B., Trajtenberg, M. 1998. Universities as a source of commercial technology: a detailed analysis of university patenting 1965-1988. The Review of Economics and Statistics 80 (1), 119-127.
Jensen, R . Thursby, J., Thursby, M. 2003. Disclosure and licensing of University inventions: 'The best we can do with the s**t we get to work with'. International Journal of Industrial Organization 21(9), 1271-1300.

Jensen, R., Thursby, M. 2001. Proofs and prototypes for sale: the licensing of university inventions. American Economic Review 91 (1), 240-259.
Katila, R, Ahuja, G. 2002. Something old, something new: a longitudinal study of search behavior and new product introduction. Academy of Management Journal 45 (6), 1183-1194.
Landry, R., Saïhi, M., Amara, N., Ouimet, M. 2010. Evidence on how academics manage their portfolio of knowledge transfer activities. Research Policy 39 (10), 1387-1403.
Langford, C.H., Hall, J., Josty, P., Matos, S., Jacobson, A. 2007. Indicators and outcomes of Canadian university research: proxies becoming goals. Research Policy 35 (10), 1586-1598.
Lavie, D., Rosenkopf, L. 2006. Balancing exploration and exploitation in alliance formation. Academy of Management Journal 49 (4), 797-818.
Leiponen, A., Helfat, C.E. 2010. Innovation objectives, knowledge sources, and the benefits of breadth. Strategic Management Journal 31 (2), 224-236.
Lichtenthaler, U. 2009. Absorptive capacity, environmental turbulence, and the complementarity of organizational learning processes. Academy of Management Journal 52 (4), 822-846.
Link, A.N., Siegel, D.S., Bozeman, B. 2007. An empirical analysis of the propensity of academics to engage in informal university technology transfer. Industrial and Corporate Change, 16 (4), 641–655.
Makino, S., Delios, S., 1996. Local knowledge transfer and performance: Implications for alliance formation in Asia. Journal of International Business Studies 27 (5), 905-927.
Mansfield, E. 1991. Academic research and industrial innovation. Research Policy 20 (1), 1-12.
Mansfield, E. 1998. Academic research and industrial innovation: An update of empirical findings. Research Policy 26 (7-8), 773-776.
March, J.G. 1991. Exploration and exploitation in organizational learning. Organization Science 2 (1), 71-87.
Meyer, M. 2006. Academic inventiveness and entrepreneurship: on the Importance of start-up companies in commercializing academic patents. Journal of Technology Transfer 31 (4), 501-510.
Nerkar, A., Shane, S. 2007. Determinants of invention commercialization: an empirical examination of academically sourced inventions. Strategic Management Journal 28 (11), 1155–1166.
Nunnally J C. 1978. Psychometric theory. New York: McGraw Hill.
O'Reilly, C.A., & Tushman, M.L. 2008. Ambidexterity as a dynamic capability: Resolving the innovator's dilemma. Research in Organizational Behavior 28 (1), 185–206.
OECD. 1991. The nature of innovation and the evolution of the productive system, technology and productivity - the challenge for economic policy. OECD, Paris. 303–314.
Perkmann, M., Walsh, K. 2007. University-industry relationships and open innovation: towards a research agenda. International Journal of Management Review 9(4), 259-280.
Perkmann, M., Walsh, K. 2008a. How firms source knowledge from universities: partnering versus contracting. In Bessant, J., Venables, T. (eds.) Creating Wealth From Knowledge. Pp. 273-296, Cheltenham, UK: Edward Elgar.
Perkmann, M., Walsh, K. 2008b. Engaging the scholar: three type of academic consulting and their impact on universities and industry. Research Policy 37 (10), 1884-1891.
Podsakoff, P., Organ, D. 1986. Self-reports in organizational research: problems and prospects. Journal of Management 12 (4), 531-544.
Powell, W.W., Owen-Smith, J. 1998. Universities and the market for intellectual property in the life sciences. Journal of Policy Analysis and Management 17 (2), 253-277.
Rahal, A.D., Rabelo, L.C. 2006. Assessment framework for the evaluation and prioritization of academic technology for licensing and commercialization. Engineering Management Journal 18 (4), 28-36.
Rogers, E.M., Yin, J., Hoffmann, J. 2000. Assessing the effectiveness of technology transfer offices at U.S. research universities. Journal of the Association of University Technology Managers 12, 47-79.
Rothaermel, F.T., Deeds, D.L. 2004. Exploration and exploitation alliances in biotechnology: a system of new product development. Strategic Management Journal 25 (3), 201-221.
Santoro, M.D., Bierly, P.E. 2006. Facilitators of knowledge transfer in university-industry collaborations: a knowledge-based perspective. IEEE Transactions on Engineering Management 53 (4), 495-507.
Santoro, M.D., Chakrabarti, A. K. 2002. Firm size and technology centrality in industry-university interactions. Research Policy 31 (7), 1163–1180.
Santoro, M.D., Gopalakrishnan, S. 2001. Relationship dynamics between university research centers and industrial firms: their impact on technology transfer activities. Journal of Technology Transfer 26 (1-2), 163-171.
Schartinger, D., Rammer, C., Fischer, M. M., Fröhlich, J. 2002. Knowledge interactions between universities and industry in Austria: sectoral patterns and determinants. Research Policy 31 (3), 303–328.
Shane, S. 2002. Selling university technology: patterns from MIT. Management Science 48 (1), 122-137.

Tatikonda, M.V., Stock, G.N. 2003. Product technology transfer in the upstream supply chain. Journal of Product Innovation Management 20 (6), 444-467.

Thursby, J., Jensen, R., Thursby, M. 2001. Objectives, characteristics and outcomes of university licensing: a survey of major US universities. Journal of Technology Transfer 26 (1-2), 59–72.

Thursby, J., Thursby, M. 2002. Who is selling the ivory tower? Sources of growth in university licensing. Management Science 48 (1), 90–104.

Thursby, J., Thursby, M. 2004. Are faculty critical? Their role in university– industry licensing. Contemporary Economic Policy 22 (2), 162–178.

Todorova, G., Durisin, B. 2007. Absorptive capacity: valuing a reconceptualization. Academy of Management Review 32 (3), 774-786.

Tsang, 2002. Acquiring knowledge by foreign partners from international joint ventures in a transition economy. Strategic Management Journal 23, 835–854.

van Wijk, R., Jansen, J.J.P., Lyles, M.A. 2008. Inter- and Intra-organizational knowledge transfer: a meta-analytic review and assessment of its antecedents and consequences. Journal of Management Studies 45 (4), 830-853.

Wang, C.C., Kuo, C.K. 2004. Logistic Regression Models: Methods and Application. Taipei: Wunan (in Chinese).

Wang, C.L., Ahmed, P.K. 2007. Dynamic capabilities: a review and research agenda. International Journal of Management Review 9 (1), 31-51.

Zahra, S.A., Nielsen, A.P. 2002. Sources of capabilities, integration and technology commercialization. Strategic Management Journal 23 (5), 377–398.

Table 1. Measurement and factor loadings of strategic intent

Variable	Factor loading Internalization-seeking	Efficiency-seeking	Resource-seeking	Item-to-total correlation Internalization-seeking	Efficiency-seeking	Resource-seeking
Obtain advanced knowledge	0.77	0.13	0.27	0.67		
Accumulate R&D experience	0.75	0.28	0.00	0.63		
Reduce internal R&D costs	0.73	0.21	-0.15	0.58		
Access licensed research findings or prototype	0.64	-0.04	0.36	0.46		
Expand product assortment	0.61	0.32	0.04	0.49		
Reduce use of materials	0.24	0.89	0.23		0.91	
Increase yield rate	0.14	0.85	0.22		0.78	
Replace outdated products	0.39	0.79	0.19		0.78	
Use equipment and facilities unavailable internally	-0.06	0.40	0.73			0.60
Access key materials	0.02	0.30	0.81			0.56
Facilitate technology commercialization	0.47	0.00	0.69			0.46
Eigenvalue	4.71	1.69	1.19			
Percent variance explained	42.81%	50.62%	69.04%			
Cronbach's α of scale				0.78	0.91	0.74

Note: Extraction method: Principal component analysis. Rotation method: Varimax with Kaiser normalization

Table 2. Item-averaged descriptive statistics

	Item	Mean	S.D.	Minimum	Maximum	Reliability
Licensing	1	0.56	0.499	0	1	-
R&D cooperation	1	0.78	0.416	0	1	-
Patent	1	0.54	0.501	0	1	-
Collaboration experience	1	0.58	0.496	0	1	-
SME	1	0.21	0.409	0	1	-
ICT industry	1	0.40	0.492	0	1	
Biotech industry	1	0.33	0.473	0	1	-
Other industry	1	0.27	0.449	0	1	-
Efficiency-seeking	3	3.87	1.891	1.0	7.00	0.91
Resource-seeking	3	4.41	1.494	1.0	7.00	0.74
Internalization-seeking	5	5.47	1.076	1.8	7.00	0.78
Exploitative capability	4	5.08	1.526	1.75	7.00	0.90
Exploratory capability	4	5.86	1.187	2.00	7.00	0.89
Exploitative-Exploratory capability gap	1	-0.78	1.346	-4.00	3.00	-
Exploitative-Exploratory capability combination	1	30.70	12.438	4.00	49.00	-

Note: Number of observations is 91.

Exploitative-Exploratory capability gap＝Exploitative capability－Exploratory capability

Exploitative-Exploratory capability combination＝Exploitative capability × Exploratory capability

Table 3. Pearson correlation matrix

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Licensing												
2. R&D cooperation	**-0.36**											
3. Patent	-0.11	-0.12										
4. Collaboration experience	0.10	-0.07	0.16									
5. SME	-0.14	0.14	-0.12	-0.06								
6. ICT industry	-0.14	-0.11	**-0.20**	0.05	-0.08							
7. Biotech industry	0.15	-0.08	0.09	-0.12	0.16	**-0.57**						
8. Other industry	-0.00	**0.21**	0.13	0.07	-0.07	**-0.50**	**-0.43**					
9. Efficiency-seeking	**0.18**	0.01	0.04	0.01	**-0.19**	**-0.28**	0.04	**0.27**				
10. Resource-seeking	**-0.19**	**0.26**	**0.23**	-0.05	-0.05	**-0.21**	0.09	0.13	0.00			
11. Internalization-seeking	-0.14	**0.29**	0.07	0.02	0.04	-0.02	-0.05	0.07	0.00	0.00		

12.	Exploitative-Exploratory capability gap	**0.22**	-0.17	0.00	**-0.20**	-0.10	-0.16	0.15	0.01	**0.36**	0.11	-0.05	
13	Exploitative-Exploratory combination	0.00	-0.10	**0.20**	0.03	0.00	-0.28	0.09	0.22	**0.52**	**0.29**	**0.31**	**0.36**

Note: Figures in bold indicate $p<0.10$ when |correlation|≧0.173, $p<0.05$ when |correlation|≧0.208, $p<0.01$ when |correlation|≧0.28, and $p < 0.001$ when |correlation| ≧0.36. Number of observations is 91.

Table 4. Logistic regression estimates

Model	Licensing (a)			R&D cooperation (b)			VIF
Efficiency-seeking intent	0.25	(0.321)		**0.88**	**(0.468)**	*	1.42
Resource-seeking intent	**- 0.49**	**(0.290)**	+	**1.20**	**(0.374)**	***	1.16
Internalization-seeking intent	**- 0.74**	**(0.395)**	+	**0.89**	**(0.435)**	*	1.44
Exploitative-Exploratory capability gap	**0.40**	**(0.225)**	+	- 0.51	(0.318)		1.30
Exploitative-Exploratory capability combination	- 0.00	(0.031)		**- 0.07**	**(0.036)**	+	1.07
Internalization-seeking intent × Exploitative-Exploratory capability gap	**- 0.56**	**(0.287)**	+	- 0.14	(0.347)		1.66
Patent	**- 1.07**	**(0.592)**	+	- 1.12	(0.753)		1.20
Collaboration experience	0.79	(0.543)		- 0.62	(0.706)		1.11
SME	- 0.90	(0.635)		1.50	(0.981)		1.11
ICT industry	- 1.00	(0.678)		- 1.42	(0.985)		1.81
Biotech industry	0.53	(0.634)		- 1.24	(0.975)		1.61
Constant	1.26	(1.169)		5.11	(1.588)	**	
Correctly classified	71.4%			82.4%			
Model χ^2	**24.53**		*	**31.11**		***	
-2 Log likelihood	100.29			64.73			
Pseudo Nagelkerke R^2	0.32			0.45			
H&L χ^2	5.37			10.85			

Note: + $p<0.10$, * $p<0.05$, ** $p<0.01$, *** $p < 0.001$. Number of observations is 91.
Figures shown are beta coefficients of the logistic regressions. Figures in the parenthesis are standard errors. Positive coefficients are associated with greater probability of dependent variable.

ANALYZING THE IMPACT OF THE INTERACTION PROJECTS BETWEEN BRAZILIAN FEDERAL UNIVERSITY AND OIL COMPANY

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Abstract: This study aims at analyzing the impact caused by interaction projects between Federal University of Rio Grande of Sul (UFRGS) and Brazilian Petroleum Company SA (PETROBRAS), promoted by sectoral funds and government incentives. A survey was carried out about the projects aiming at performing R&D at UFRGS' three academic units with the highest number of interaction projects: School of Engineering (SE), Geosciences Institute (GI) and Institute of Chemistry (IC). Based on a survey and a statistical analysis, the results of the projects were associated considering its origins (demand by the company, initiative by the researcher and research history). Starting from this analysis, the results of the projects were addressed regarding the scientific, technological and strategic impacts both for UFRGS and PETROBRAS.

Keywords: University-Company Interactions; Impacts of Science and Technology; R&D Projects; Oil Industry; Government Incentives.

1 INTRODUCTION

The interaction between the institutions of science and technology (IST), more specifically universities, and the productive sector is an important strategic issue. This relationship enables a means of enhancing R&D activities, and thus enhances the technological competitiveness of companies and the scientific advancement of research institutions. These economic sectors, involved in the process of national technological development and innovation, are presented in a complementary manner for the achievement of goals which are mutually beneficial and at the same time different.

The academy, the government and industry consider technology as a major source of competitiveness, bringing technological innovation as a catalyst for economic development, and quality and productivity improvement, while simultaneously improving the standard of social life. These conditions are essential for companies to develop a position with technological focus in order to define strategies to increase the level of the existing technologies and access and absorb the new ones, aiming mainly at the implications of scarce resources and the costs implicit in the development of innovations and techniques necessary for their competitiveness (VEDOVELLO, 1997; VASCONCELOS and FERREIRA, 2000; SEGATTO-MENDES, 2001; COUTINHO, 2004; COUTINHO, 2007). For certain strategic sectors, particularly energy (oil and natural gas), technological innovations tend to be more complex. Thus, technology transfer is one of the most intense forms of realizing the exchange of knowledge and technological skills between companies and ISTs (COUTINHO, 2007).

PETROBRAS is remarkably a company that permeates the international technological frontier in its sector of activity, assuming a unique characteristic in relation to its leadership in technological advancement in a developing country (FURTADO, 1996). However, the company is in constant technological challenge in order to ensure the development and expansion of its activities globally. The recent discoveries of new oil reservoirs, of large volumes, will require from the company and the country an effective response for a technological demand which will enable and sustain strategies for expansion (ZAMITH and SANTOS, 1998; COUTINHO, 2007).

The relationship between ISTs and PETROBRAS was consolidated prior to the legal changes in national context (such as the Petroleum Law and the Law of Technological Innovation). However, the breaking of monopoly and the demand for productivity, together with the mechanisms that favor the interaction with ISTs and other companies, made this company to define a new strategic policy to manage the necessary innovation and technology transfer required for its growth. With this objective, PETROBRAS has defined a system of thematic research networks linked to the investment policies in R&D.

This policy considers the application resulting from the National Science and Technology Plan for the Petroleum and Natural Gas Sector) – CTPETRO and also from the Special Share), stipulated by the Federal Law No. 9.478/97.

These changes equally streamlined the policy of technological development for the sector and the national economy as a whole, allowing the growth of various strategic segments for the society (CTPETRO, 1999; AYUP-ZOUAIN, 2008; PETROBRAS, 2009).

The domestic oil production and the consequent generation of wealth were only made possible by the existence of activities of research, development and product and process engineering, involving the work of research teams who are dedicated to the development of science and technology applied to oil and gas industry and investors who believed in the potential of S&T institutions (CTPETRO, 1999).

However, it is important to highlight the results of this interaction by assessing the responsiveness of the academic sector to the demands of the company at strategic and operational levels, optimizing these benefits in the medium and long term. The scientific expertise and of knowledge dissemination, which is one of the main functions of the academic sector, is also an object of evaluation, especially when made from the demand of the productive sector. For the university, the results of this partnership are beneficial, contributing to their social and economic insertion, generating scientific and technological advancements and forming new professionals who will be better qualified for market and society.

Thus, the main goal presented in this paper is to analyze the impact resulting from interaction projects between the Federal University of Rio Grande of Sul (UFRGS) and Petrobras Brazilian Company S/A promoted by sector funds and government incentives. Section 2 presents the theoretical reference of interaction between universities, companies and government, the context of science and technology policies in Brazil, the legal framework and the technological challenges of the energy sector. Section 3 presents the Methodological Procedures performed for the preparation of this paper and Section 4 presents the Result Analysis. Section 5 presents the conclusions of the survey.

2 THEORETICAL REFERENCE

2.1 Interaction between Universities, Companies and the Government

Innovation and technological progress are the result of a complex set of relationships among the parties producing, distributing and applying knowledge from various areas. The innovatory performance of a country depends largely on how the parties relate to each other as elements of a collective system of knowledge creation and utilization, as well as the technology used. Interactions can take the form of joint research, personnel interchange, patents in co-ownership, equipment acquisition and infrastructure adequacy, among other ways (OCDE, 1997b).

Plonski (2005) addresses the need for a coordinated movement for the advancement of the cooperative relationship between scientific-technological institutions, companies and the government, represented in triadic models, such as the “Sábato’s Triangle” and the Triple Helix. The Sábato’s Triangle, proposed by Sábato and Botana in 1968, refers to a model to access and enter the S&T in the development process of nations by the means of the multiple and coordinated action of three fundamental elements: the government, the productive structure and the scientific-technological infrastructure.

The Triple Helix of Relations University-Industry-Government defines government as the principal agent in promoting interaction between industries and universities which, to date, had their institutional roles separate and distinct, and now have incentives on one side and pressure on the other, respectively, so as to foster a superior performance in the

traditional activities and functions of universities (ETZKOWITZ e LEYDESDORFF, 1995). Nelson and Rosenberg (1993) emphasized the role of universities in a National Innovation System, operating as sources of scientific knowledge and research that provide useful techniques for the industrial technological development, besides being educators of scientists and engineers.

To Marchiori and Colenci Jr (1998), “technology transfer is a process of transferring knowledge and specific competences, developed from researches, which aims at promoting the technological capability of interested companies.” To Feldam et al (2002), universities have experienced and embraced alternative mechanisms for transferring intellectual property. The participation of companies by the means of royalty payments (percentage of profits or revenue) or awards by the use of the university’s intellectual property are emergent mechanisms. Agreements in which the university receives a share in the profits of a company in exchange for providing the company the license to use the university’s rights of invention are becoming common.

The operations of technology transfer have multiple objectives: they narrow the links between universities and industries, increase the prestige of the university, and increase and accelerate the technology transfer for economic and social benefit of the region or nation. All technological cooperation is made possible by the collaboration between companies and educational institutions and research institutions for the development of products and processes. In general, this kind of cooperation brings together universities and companies for the training of human resources, access to laboratories, research support, technology development and technology transfer. This whole environment is linked to what we call university-industry interaction, bringing together all the technology and knowledge transfer activities between the academy and industries in order to promote innovation (ANPROTEC, 2002).

Mowery and Sampat (2005) present studies about the importance of university research to technological advancements and the interaction between universities and industries. The authors indicate some important "products" from the economic point of view resulting from academic research, such as scientific and technological information, equipment and instrumentation, human capital, networks of scientific and technological capacity and the development of prototypes of new products and processes.

The main focus of these projects and interactions involving these three agents of cooperation (Universities, Industries and the Government) assume a leading role in promoting innovations that reflect significant social and economic advancements. Thus, highlighting innovation as a product of the various forms of technology transfer is important for the economies of nations to be streamlined. In Figure 01, the main objectives of innovation can be observed, as shown by the Oslo Manual.

FIGURE 01: Objectives of Innovation
Source: Adapted from the Oslo Manual (OCDE, 2004).

The types of innovation were also examined in order to identify how the results of the projects would impact in terms of innovation in the company. According to ANPROTEC (2002) and the Oslo Manual (OECD, 2004), the types of innovation can be classified as shown in Figure 02. The objectives and types of innovations presented were obtained based on processes of technology transfer that can occur under several aspects. Among the main technology transfer mechanisms usually resulting from the process of interaction between universities, companies and government support, there are those described in Figure 03.

In technological products	Placing on the market of new or improved products, resulting from the use of new knowledge, changes in equipment and/or organization of production.
In technological processes	Adoption of new or improved production methods, resulting from the use of new knowledge, equipment changes and/or organization of production.
In marketing	It involves the implementation of new marketing methods, which may include changes in appearance of the product and its packaging, in dissemination and distribution, and methods for setting prices of benefits and services.
Organizational	Renewal of procedures and methods of organizing companies, suppliers, manufacture and commercialization of goods and services.
Radical	Introduction of new product or process, or the renewal of the organizational form of production which can result in structural break from the technological standard hitherto used, giving rise to new industries, sectors or markets.
Incremental	Introduction in a company, without changing its industrial structure, of any kind of improvement in product, process or production organization.
Technological	Introduction of products and processes which are technologically new or improved.

FIGURE 02 – Types of Innovation

Source: Adapted from the ANPROTEC (2002) and the Oslo Manual (OCDE, 2004).

Technology licensing	Contractual agreement whereby one organization sells to another company the rights to use its technology in the form of patents, process and/or technical know-how, copyright, trademark and applications for invention, and for which it receives royalty payments and/or other form of compensation.
Know-how	Technical expertise; know-how. Refers to non-patented manufacturing processes, but which requires great skill. It also refers to a set of operations that require specific expertise, consultancy, technical assistance, provision of services.
Patent	Temporary ownership of invention, utility model or industrial design awarded by the State to the inventor, author, person or entity that holds rights over the creation. A patent gives its holder a legal situation, by which the patented invention can be exploited (manufactured, imported, sold and used), with permission of the owner.
HR formation	Extension courses, undergraduate and postgraduate education, specialization, training, qualification.
Spin-off	A company whose origins stem from laboratory and results from academic or industrial research.
Spin-out	A company boosted by another company already established in the market to act in the same business area, but with a product or service different from that one sold by the original company.
Research	*Applied Research* : Original investigation conceived by the interest in acquiring new knowledge, directed to specific practical purpose and held both to determine possible uses for discoveries of basic research and to define new methods or ways to achieve a certain goal.
	Basic research : Theoretical or experimental study aiming at contributing to the understanding of observable facts and phenomena, analyzing properties, structures and connections, verifying and/or generating hypotheses and theories, without concern for immediate and specific use or application of its results.
	Experimental research and development. R&D : Systematic and creative investigation that aims at broadening and reapplying the knowledge. In its most important stage, R&D involves prototype construction and testing.
	Research in consortium or cooperative Research : Scientific studies carried out in partnership for the feasibility of processes, products and/or services that require complementary resources, equipment and knowledge
International cooperation	Exchange between educational institutions, research, laboratories, and foreign companies.
Business incubators	(a) Core agent in the generation and consolidation process of micro and small companies;
	(b) Mechanism that encourages the creation and development of micro and small industrial companies or service providing companies, technology-based or light manufacturing companies, by the means of further training of entrepreneurs in their technical and managerial aspects;
	(c) Facilitating agent of business processes and technology innovation in micro and small companies.
Technological parks	(a) Planned science/technology-based industrial complex, of formal character, focused and cooperative, which aggregates companies whose production is based on technological research developed in R&D centers linked to the Park;
	(b) Enterprise which promotes culture innovation, competitiveness, increase of the business capacity based on knowledge and technology transfer, aiming at enhancing the production of wealth.

FIGURE 03 – Technology Transfer Mechanisms

Source: Adapted from ANPROTEC (2002) and STAL (2004)

2.2 Context of Brazilian policies on science and technology

From the 1950s on, Brazil relies on government mechanisms of encouragement to research and development in universities, with import substitution policies for consumer durables and investment in infrastructure, such as in energy and minerals. Throughout this period, the *Brazilian Federal in Higher Education* (CAPES) and theNational Council for Scientific and Technological Development (CNPq) were established, in 1951.

Almost two decades later, the government created the National Fund for Scientific and Technological Development) – FNDCT, managed by the Financier of Studies and Projects (FINEP) (established in 1967). This is, so far, one of the main governmental mechanisms to encourage scientific and technological development, mainly directed to the interaction between the productive sector and the ISTs. Thus, the Brazilian government encourages technological modernization in Brazil, encouraging not only R&D in industries and universities individually, but especially in joint actions of these institutions (SEGATTO, 1996; VASCONCELOS, 2000; VALLE et al., 2002; BANCO MUNIDAL, 2008).

Since 1990, the policies of science and technology (S&T) designed to stimulate integrated innovation with companies were based on tax incentive mechanisms for the R&D activities and technological capabilities. A major change in this policy was the creation of sector funds in 1999, directed towards national strategic sectors. These funds were intended to ensure the flow of resources for the promotion of science, technology and innovation, through revenues from firms which were privatized in that government (BALESTRO, 2006).

The legal mark established with the approval of the Petroleum Law (Law No. 9,478/1997 – Brazil) brought institutional changes and elements that helped to streamline the oil and natural gas sector, especially in relation to the technological development of the Brazilian economy. The main change was to allow the entry of domestic and foreign private companies to act in the same productive context, as a consequence of the break of the state monopoly over activities of exploration, production, refining and transportation of oil, natural gas and co-products (FURTADO, 2003). The Petroleum Law also deals with the distribution of royalties to be collected for the Federal Government resulting from the production of oil and natural gas, of which 25% of the surplus and 5% of the production should be transferred "...to the Ministry of Science and Technology (MST) to fund programs supporting scientific research and technological development applied to the oil industry" (Law No. 9,478/1997; PEREIRA, 2007).

This Law also says that the MST will manage the programs with technical support from the National Agency of Petroleum, Natural Gas and Biofuels) – ANP, through agreements with universities and research centers in the country (CTPETRO, 1999). The National Agency of Petroleum, Natural Gas and Biofuels – ANP, based on that law, is the regulator of the activities that comprise the industries of the petroleum, natural gas and biofuels energy sector, being responsible for executing the national policy for the sector. It regulates hires and supervises the activities of the operating industries, also carrying out the task of promoting the development of the regulated sectors (ANP, 2008).

Similarly, the concessionaires of the sector have stated both in public notices and contracts that, besides the usual taxes, companies must pay royalties to Municipalities, States and the Union. And in the case of the fields of great production volume and profitability, companies should also pay special shares. This special share, defined according to Law No. 9,478/97 and Decree No. 2,705/98, "must be applied on the gross revenue of the production, deducting royalties, exploration investments, operating costs, depreciation and taxes established in the active law". Therefore, the concession contracts will define mandatory governmental shares, which are defined under four aspects, as shown in Figure 04 (CTPETRO, 1999; PEREIRA, 2009).

I – signing bonus	Minimum value established in the public notice and which is equal to the payment offered in the tender for the concession. It shall be paid upon signing the contract.
II – royalties	Paid monthly in national currency, in an amount equal to ten percent of the production of oil or natural gas.
III – special share	The special share will be applied on the gross revenue of the production, deducting royalties, exploration investments, operating costs, depreciation and taxes established in the active law.
IV – payment for area occupation or retention	Payment for area occupation or retention, to be made annually, fixed per square kilometer or fraction of the surface of the block.

FIGURE 04: Contractual obligations of the concessionaires
Source: Adapted from Law no. 9,478/1997.

The Resolution N° 33 of the ANP, 2005, requires concessionaires to invest in Brazil the value corresponding to 1% of the gross revenue of the production of a particular oil field in the realization of expenditures classified as R&D. Another determination of ANP requires concessionaires *to invest at least 50% of this amount on costs incurred in contracting projects and/or programs in universities and R&D institutes*, provided they have been accredited by the agency for this purpose. These changes created an appropriate environment for cooperation between universities and companies in the energy sector, especially concerning R&D and technological innovations, in reason of experience and qualifications demanded.

Therefore, it is seen that from the legal mark and the technical regulations created in the sector by ANP, as a result of the Special Share and the Sectoral Funds, there are opportunities to explore a broad scientific and technological potential allocated in the country, generating strategic capabilities to the energy sector, mainly the oil and gas sectors. This condition establishes a benchmark, streamlining research actions aimed at the challenge of generating new technologies and innovations for the partners involved. The technological challenge that the oil industry has is directly related to its development, and especially to the production systems that are linked to the proper exploration and appreciation of reservoirs located in great depths (FURTADO, 1996; FURTADO, 2003). The institutional change which occurred is also reflected in a major challenge for national suppliers, who have had to face a new competitive environment (MARZANI et al., 2003).

With the National Science and Technology Plan for the Petroleum and Natural Gas Sector – CTPETRO, conducted by the National Council of Energy Policy) – CNPE, created by Law No. 9,478/97 and Decree No. 2,851/98, there is a set of programs to support scientific research and technological development applied to the petroleum industry. The main objective of CTPETRO is to contribute to the sector's sustainable development. Among the main strategies is to mobilize the S&T community for participative action, optimizing investments and sharing resources, directing R&D activities and qualification of human resources, stimulating the production of programs and projects involving cooperation between research centers, universities and companies that are part of the circuit comprising interests of the final production of the product or process, encouraging the establishment of cooperative research and innovation networks, among others (Directive MCT No. 552, December 8, 1999; VALLE, et al. 2002; AYUP-ZOUAIN, 2008).

In the actions promoted by CTPETRO, there is the initiative to consolidate a sectoral system of innovation, when promoting the articulation of the scientific and technological institutions in the country involved in the technological development process of the oil and natural gas sector, becoming even more integrated with companies of capital goods, oil companies and engineering companies (FREITAS, 2002).

The Federal Law No. 10,973, December 2, 2004, known as the Brazilian Innovation Law, also establishes a landmark to promote interaction between companies and ISTs. This Law deals with incentives to innovation and scientific and technological research in a productive environment, which, in addition to establishing flexibility for cooperation between universities and companies, presents support to the creation of environments for innovation (Law No. 10,973/2004; FIGLIOLI, 2007).

With the new configuration of the legal environment and of the S&T policies, PETROBRAS has established some strategies for structuring its policy of innovation, technological development, and especially of interaction with ISTs, in particular with universities, creating a model of technological partnership. This model was proposed by CENPES and articulated with all areas involved with the Technological System of PETROBRAS. Based on this model, two patterns of strategic relationship with the national ISTs were proposed: competence nuclei and thematic networks. To do so, since 2006, the PETROBRAS Technological System and the Thematic Networks for the execution of strategic policies have been presented, based on Technical Regulation N° 05/2005 of ANP, making the relationship of technological partnership even more intense and adapting the favorable environment for strengthening the strategic interests not only of the company, but also those from the entire national scientific and technological community. The thematic network model adopted by PETROBRAS essentially presents the technological aspects of strategic interest of the company. Projects are developed through collaborative networks between institutions of recognized competence in the topics selected, as shown in Figure 05.

THEMATIC NETWORKS			
1) EXPLOITATION	Applied Geophysics	2) PRODUCTION	Monitoring, Control and Automation of Wells
	Geochemistry		Computing and Scientific Visualization
	Sedimentology and Stratigraphy		Water Management in Oil Production Segment
	Tectonics		Materials Technology and Corrosion Control
3) SUPPLY	Asphalt Technology		Revitalization of Mature Fields
	Computational Fluid Dynamics in Refining Processes		Heavy Oils
	Concrete and Refractories for the Petroleum Industry		ReservoirManagement and Simulation
	Instrumentation, Automation, Control and Process Optimization		Oceanographic Modeling and Observation
	Development of Technologies for Clean Fuels		Submarine Structures
	Center of Development of Products and Processes for Refining	4) GAS, ENERGY AND SUSTAINABLE DEVELOPMENT	Nanotechnology Applied to Energy Industry – Nanocatalysis and Nanomaterials
	Development of Catalysts		Hydrogen: Production, Use and Storage
	Vehicle Development		Research in Bioproducts
	Center of Materials Applied to PetroleumRefining		Center of Technology Development of Natural Gas
	Excellence in Oil Supply Chain		Climate Changes
	Metrology		Planning, Management and Regulation in Oil, Natural Gas, Energy and Sustainable Development
	Shipbuilding Technology		Marine Environmental Monitoring
	Center of Technology in Pipelines		Conservation and Restoration of Ecosystems and Remediation of Impacted Areas
5) TECHNOLOGICAL MANAGEMENT	Technological Prospecting		
	Integration S&T-Industry in National Productive Process		
	Management Process Methodology of Technological Innovation		
	Converging Technologies		

FIGURE 05: Thematic Network of PETROBRAS System
Source: Adapted from PETROBRAS (2009).

3 METHODOLOGICAL PROCEDURES

The methodological procedure included a qualitative and quantitative approach, structured into the following steps: 1) Data Collection: (i) Bibliographical Research, (ii)
Survey (preparation of the research instrument, selection of units of analysis (sample) and application of the research instrument), 2) Multivariate data analysis – Crosstabs and correspondence analysis – SPSS®, and 3) Presentation of the results.

3.1 Data Collection

3.1.1 Bibliographical Research

A bibliographical survey was carried out about the main articles on the university-company-government interaction, technological development and innovation, technology transfer and legislation for the energy sector, including the history of PETROBRAS and UFRGS institutions.

3.1.2 Survey

This step comprised the development and implementation of a closed questionnaire with questions concerning the origin of the projects and the results obtained by executing these, considering the scientific, technological and strategic impacts for both UFRGS and PETROBRAS.

Interviews were conducted with coordinators of interaction projects between UFRGS and PETROBRAS who are professors and researchers at the university. After contact by e-mail and telephone, informing about the research objectives, the respondents agreed to participate, allowing the recording of the interview. The interviews were guided by a questionnaire containing 19 multiple choice questions.

For each response a grade was assigned concerning the degree of impact, using a 1-10 scale. The grade was assigned according to the perception of the professors in relation to the results of the project executed under their supervision. No employees were interviewed. Concerning PETROBRAS, no researchers involved in the projects were interviewed.

The data obtained were of primary (questionnaire results) and secondary (database of contracts and agreements, provided by the Department of Technological Development of UFRGS) origin.

In order to define the sample, the number of total projects by academic units and the object of the interaction of these projects were found. The number of projects analyzed (between the years 2004 to 2008) totaled 81, as follows: 33 from the School of Engineering (SE), 24 from the Geosciences Institute (GI), and 12 from the Institute of Chemistry (IC), and the others distributed among other academic units at UFRGS. Thus, the projects selected were from the academic units that had more interaction projects. The amount of the projects totaled more than 90 million reais (about US$ 50 million). Regarding the dimension of the projects, at UFRGS the ones up to R$ 250,000 (US$ 140,000) are considered as small. By way of definition for this research, it was determined that medium-sized projects are those over R$ 250,000 (from US$ 140,000 to US$ 500,000) to R$ 1 million, and projects over R$ 1 million (US$ 500,000) are considered as large.

The sample definition was determined by judgment, selecting the three academic units with higher number of interaction projects with PETROBRAS. The project selection specifically considered the object of the interaction, i.e., the scope of the project executed. In this case, the projects selected were those whose goal was to carry out R&D, with the projects in which the object was only the installation of physical infrastructure or provision of technological services being disregarded. Once these conditions were considered, 13 projects of R&D were selected from the three major academic units, with 07 from SE, 03 from GI, 03 from IC, among which 06 were large, 05 medium and 02 small. The coordinators of each project selected were interviewed, totaling 13 interviews. Voice recorder was used to assist in the collection of information.

3.2 *Multivariate Data Analysis*

Data analysis was performed with the application of Crosstabs and Correspondence Analysis to a stratification variable, defined based on the origin of the projects, with such origin being the way by which the opportunity of completion of the project was identified, with the possibilities being (i) by demand/order of PETROBRAS, (ii) by initiative of the researcher who identified the partnership or opportunity to develop the project for PETROBRAS and (iii) by the fact that there was a research history and application was found at PETROBRAS.

Correspondence analysis is an interdependence technique directed toward dimensional reduction and perceptual mapping. It is a compositional technique based on the association between goals and a set of descriptive characteristics or attributes specified by the researcher. The goal is to determine the frequency with which two or three variables appear together and portray the correspondence of the categories of variables, measured in nominal scales, serving as a basis for developing perceptual maps (cluster points). This analytical technique then generates a perceptual map (of spatial points), in which categories are represented in the multidimensional space, allowing their cognitive grouping. The proximity indicates the level of association between the row and column categories (HAIR et al., 2005).

Correspondence analysis uses the statistical concept of chi-square contingency tables to standardize the values of frequency and form the basis for the associations (HAIR et al., 2005). The chi-square test was used to evaluate the association between variables X and Y, considering adjusted residue values higher than 1 (68.26% confidence). This confidence level was set due to the sample size being small. The calculation of the values referring to the information obtained in the questions was fixed by the respective weights assigned by the coordinators in the interviews. This weight regarded the 1 to 10 impact on the results of each question presented. The analyses were performed with the help of the SPSS-13® software

4 RESULT ANALYSIS

4.1 Areas of Activity of PETROBRAS

Figure 05 shows the distribution of the 15 different areas of activity of PETROBRAS (PETROBRAS, 2009), considering the degree of impact of projects in each area. Figure 06 shows the distribution of these areas in relation to the origin of the projects.

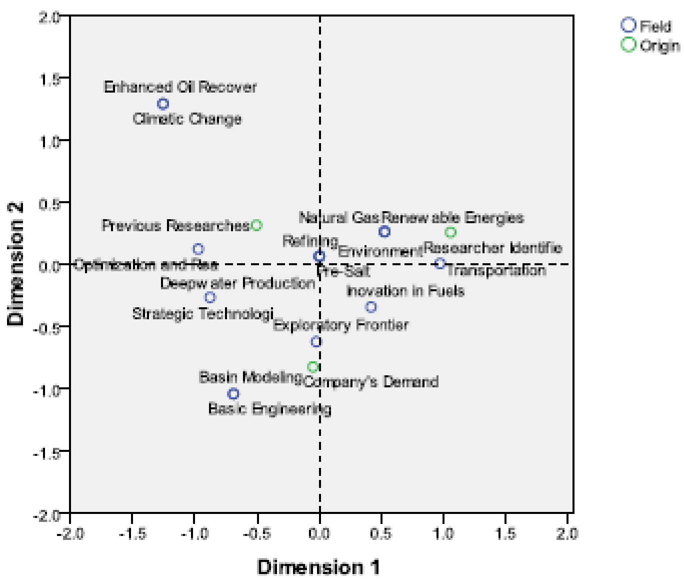

FIGURE 06 – Areas of operation of PETROBRAS concerning the origin of projects

The projects demanded by the company are more associated with the areas of Innovation in Fuels, Basic Engineering, Exploratory Frontiers, Strategic Technologies of Refining and Basin Modeling. The projects in which the researcher identified the opportunity correspond to the areas of Environment, Deepwater Production, Transportation, Natural Gas, Renewable Energies and Pre-salt. Finally, the projects originating from previous researches with application in the company are tied to the Enhanced Oil Recovery, Optimization and Reliability, Strategic Technologies of Refining and Climate Change areas.

4.2 Scientific and Technological Objectives of the Projects

The identification of the scientific and technological objectives of the project was considered aiming at relating them to the objectives of innovation suggested by the Oslo Manual (OCDE, 2004), shown in Figure 01. The Oslo Manual was designed to structure concepts, definitions and methodologies to assist in the understanding of innovation processes. With this manual it is possible to analyze guidelines that enable the development of innovation indicators and the comparison of such indicators to those of countries from the Organization for Economic Cooperation and Development – OECD. It works as a guide that provides structure and parameters for carrying out comparative researches, besides helping non-experts to better understand the topic of innovation (OECD, 2004).

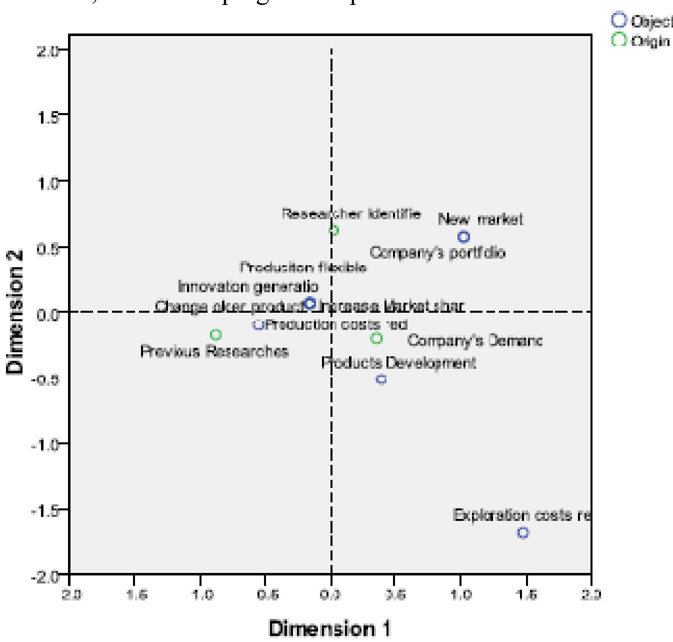

FIGURE 07 – S&T objectives of projects concerning the origin of projects

Figure 07 presents the objectives of innovation in relation to the origins of the projects. For projects originating from the company's demand, the objectives of innovation are develop environmentally friendly products, expand the product line, open new markets and reduce production costs. In projects where the researcher identified the opportunity, the objectives of innovation is increase the production flexibility, and, in case of previous researches with applications in the company, objectives of innovation are focused on create innovations in S&T, increase the production flexibility, increase or maintain market share and reduce production costs.

4.3 Types of Innovations

The possibly resulting types of innovation for the company, in relation to the origin of the projects, can be seen in Figure 08. The types of innovations were adapted from Figure 02, seen above. For projects originating from the company's demand, the type of innovation of technological products, radical and incremental, stands out. In projects where the researcher identified the opportunity, the innovations of technological processes stand out and, in case of previous researches with applications in the company, innovations are focused on organizational and technological.

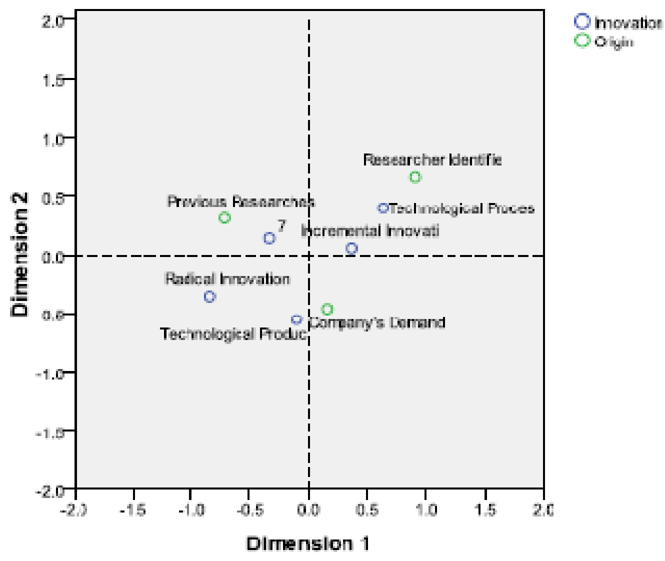

FIGURE 08- Main types of innovations

4.4 Results Subject to Protection

Figure 09 presents the results subject to protection in relation to the origin of the projects, which aimed at identifying in which areas the largest number of patents, utility models and software for universities and industry are.

As seen in Figure 09, for the projects under the company's demand, other results are highlighted, while utility models are frequent in projects in which the researcher

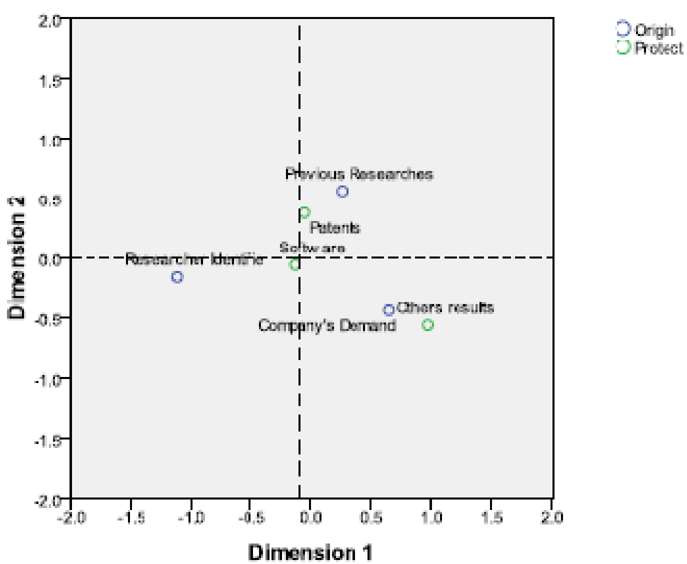

FIGURE 09 – Main results subject to protection

4.5 Main incentives for the realization of the project

This question aimed at identifying which S&T policies had encouraged the realization of projects. The main incentive mechanisms of the University-Industry interaction for the oil and natural gas sector are: Law of

Technological Innovation, Sector Funds (CTPETRO), Special Share (Petroleum Law), the National Council of Energy Policy (CNPE) and Formation of the Thematic Network of the PETROBRAS system.

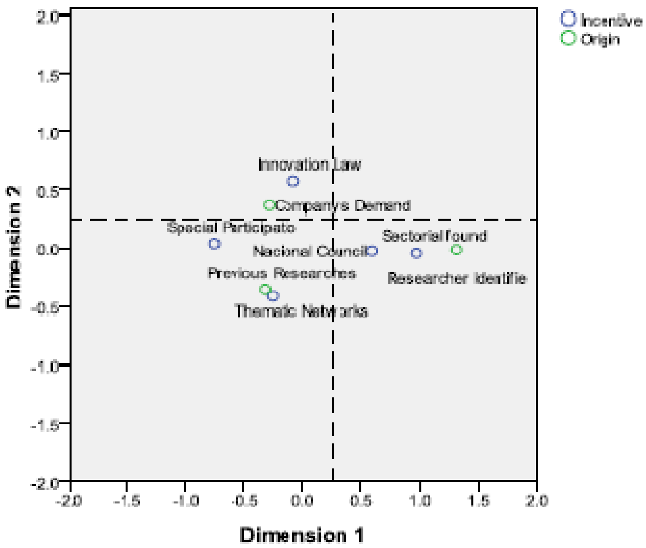

FIGURE 10 – Main incentives for the project execution

As seen in Figure 10, that shows the main incentives for the realization of projects on the basis of the origin of the projects, the projects demanded by the company highlight the Law of Technological Innovation and the policy of the National Council of Energy Policy as the main incentives for the realization of projects. In case of a researcher identifying the opportunity, the CTPETRO Sectoral Fund highlights the condition of project proposition through FINEP's public announcements. The Formation of the Thematic Networks and the Special Share are associated with projects with previous researches, demonstrating the existence of qualified researchers and researches in progress with potential applicability to the company.

4.6 Scientific and technological impacts at UFRGS

In this aspect, the goal was identifying the main science and technological impacts for UFRGS, considering the type of results obtained in carrying out the interaction projects. According to Figure 11, it is seen that the projects carried out from the company's demand have results associated with published articles and participation in events. For projects whose opportunity was identified by the researcher, the main results are scholarships, physical infrastructure and post-graduation studies. For those originating from previous researches, the results concerning the company's background formation and patents are evident.

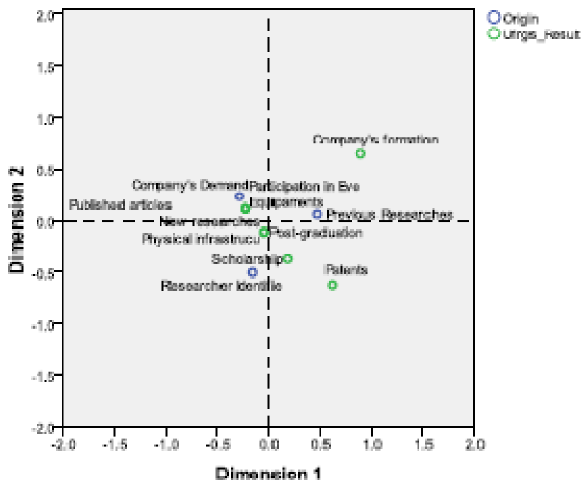

FIGURE 11 – Impacts on S&T at UFRGS

4.7 Scientific and technological impacts at PETROBRAS

The scientific and technological impacts produced at PETROBRAS from the realization of projects, considering the types of results for PETROBRAS, were also questioned. Figure 12 presents the main impacts concerning results in relation to the origin of the projects.

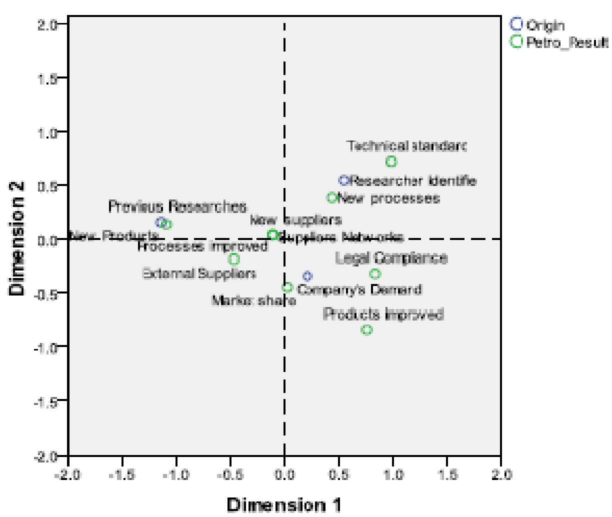

FIGURE 12 – Impacts on S&T concerning the results for the company

In Figure it is possible to see that the results of the product improvement and legal compliance types are associated with projects demanded by the company. As for the results arising from projects proposed by the researcher, the association happens with results of the new processes, legal compliance and assistance to technical standards types. In the results of the projects related to previous researches, it is possible to see generation of new products and new suppliers and the replacement of external suppliers.

4.8 Main mechanisms of technology transfer used for the delivery of results

The results of a project should be delivered to the company through certain transfer mechanisms of the technology developed, be it protected or not. The main definitions regarding the mechanisms of technology transfer (TT) presented to the coordinators can be seen in Figure 03, in the text.

Figure 13 shows the TT mechanisms used to deliver the results of the projects according to the academic units involved. As shown in Figure 15, for the delivery of the results developed in relation to the origin of the projects, the main TT mechanisms concerning the projects under the company's demand, licensing and spin-off stand out. According to the projects proposed by the researcher, licensing and know-how are the main mechanisms. In projects related to previous researches, incubated companies, technology park companies and patents cause greater impact.

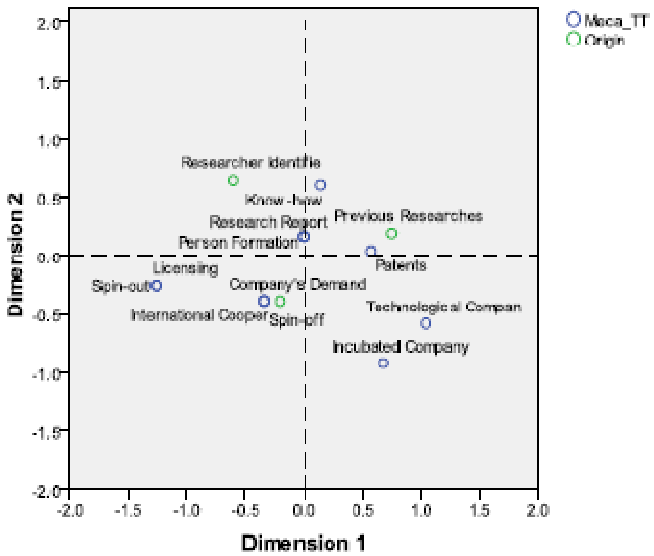

FIGURE 13 – TT mechanisms used for the transference of results developed by the project

5 CONCLUSION

The objective of this study was to analyze the impact caused by interaction projects between UFRGS and PETROBRAS, linked to policies of investment in R&D proposed by the system of thematic networks of the company. This policy concerns the application resulting from the National Science and Technology Plan for the Petroleum and Natural Gas Sector – CTPETRO and the Special Share, prescribed by Federal Law No. 9,478/97.

The methodological procedure included a qualitative and quantitative approach structured into the following steps: 1) Data Collection: (i) Bibliographical Research, (ii) Survey; 2) Multivariate data analysis – Crosstabs and Correspondence Analysis; and 3) Presentation of the results.

From the perceptual maps that show the associations of the questions with the variable origin of the projects, considering the residue values adjusted greater than 1, it was possible to identify the areas of activity of PETROBRAS, the main scientific and technological objectives of the projects, the types of innovation involved and the key features demanded by the company to carry out projects. Another relevant piece of information concerns the association about the results subject to protection and the main incentives for the realization of the project, thereby identifying the main sources of funds invested in the project.

The major scientific and technological impacts resulting from the realization of the project both within UFRGS and PETROBRAS were highlighted, as well as the impact of the project results at the strategic level of the company. The resulting benefits for both UFRGS and PETROBRAS were identified, with the effectiveness of the interaction being demonstrated. It was also possible to identify the main aspects related to the approval and hiring of the project by the company.

Concerning UFRGS, it was important to identify the main mechanisms of technology transfer used for the delivery of results, which can be encouraged, as well as ways to intervene in the course of the project for the transfer of results. Another relevant factor to enhance the interaction process is the understanding of the main determinant factors for the success of the project and the restricting factors for the proper execution of the project.

The results of the study may strengthen the interaction projects between partners, especially those of scholars of academic units involved in researches, who can better target their researches and projects according to the company's demands. The results also allow an analysis with regard to institutional aspects that may contribute to the improvement of the interaction process between UFRGS and PETROBRAS.

REFERENCES

ANP - Agência Nacional do Petróleo, Gás Natural e Biocombustíveis. Disponível em http://www.anp.gov.br Acesso em 16 ago 2008.

ANP - Agência Nacional do Petróleo, Gás Natural e Biocombustíveis. **Regulamento Técnico para o Credenciamento das Instituições de Pesquisa e Desenvolvimento.** Regulamento ANP – Nº 6/2005 - Documento aprovado pela RD nº 372, de 18 de novembro de 2005 e pela Resolução 34 de 24/11/2005 (publicado no DOU de 25/11/2005 – Seção 1).

ANP - Agência Nacional do Petróleo, Gás Natural e Biocombustíveis. **Regulamento Técnico ANP Nº 5/2005.** Disponível em http://nxt.anp.gov.br/NXT/gateway.dll?f=templates&fn=default.htm&vid=anp: 10.1048/enu Acesso em 29 ago 2008.

ANPROTEC; SEBRAE. **Glossário dinâmico de termos na área de Tecnópolis, Parques Tecnológicos e Incubadoras de Empresas**. Brasília: ANPROTEC, 2002.

AYUP-ZOUAIN, R N. **Modelo de relacionamento Petrobrás com as instituições de P&D: redes temáticas e núcleos regionais**. Porto Alegre, 2008. (Slides)

BALESTRO, M. V. **Capital Social, Aprendizado e Inovação: um estudo comparativo entre redes de inovação na indústria de petróleo e gás no Brasil e Canadá.** Universidade de Brasília – UnB. Brasília – DF, 2006. Tese (doutorado).

BANCO MUNDIAL. **Conhecimento e Inovação para a Competitividade**. Banco Mundial, tradução, Confederação Nacional das Indústrias. – Brasília: CNI, 2008.

BRASIL - Lei de Inovação Tecnológica – nº 10.973 de 02 de Dezembro de 2004. Disponível em http://www.planalto.gov.br/ccivil_03/_Ato2004-2006/2004/Lei/L10.973.htm Acesso em 23 mar 2008.

BRASIL – Lei do Petróleo Nº 9.478, de 06 de Agosto de 1997. Disponível em http://www.planalto.gov.br/ccivil_03/Leis/L9478.htm Acesso em 24 ago 2008.

BRASIL, DECRETO Nº 2.705, de 03 agosto de 1998. Disponível em http://nxt.anp.gov.br/NXT/gateway.dll?f=templates&fn=default.htm&vid=anp:10.1048/enu Acesso em 22 set 2008.

COUTINHO, P. L. A. **Estratégia tecnológica e gestão da Inovação: uma estrutura analítica voltada para os administradores de empresas**. Rio de Janeiro, 2004. Tese (Doutorado) – Universidade Federal do Rio de Janeiro – UFRJ, Escola de Química – EQ, 2004.

COUTINHO, P. L. A.; BOMTEMPO, J. V. **Inovações De Produto Em Uma Empresa Petroquímica Brasileira**. REAd – Edição 57 Vol 13 N 3 set-dez 2007. Disponível em http://read.adm.ufrgs.br/edicoes/pdf/artigo_539.pdf Acesso em 05 ago 2008.

CTPETRO - Plano Nacional de Ciência e Tecnologia do Setor Petróleo e Gás Natural – CTPETRO - Diretrizes Gerais – Versão 1 – Portaria MCT nº 552 de 08 de dezembro de 1999. MCT - Ministério de Ciência e Tecnologia. Disponível em http://www6.prossiga.br/ctpetro/docs_base/Manual_Operativo.pdf Acesso em 16 ago 2008.

FIGLIOLI, A. **Perspectivas de Financiamento de Parques Tecnológicos: um estudo comparativo**. Ribeirão Preto, 2007. Dissertação de mestrado.

FREITAS, A. G. **Novo instrumento de política científica e tecnológica no setor petrolífero nacional: a experiência do CTPETRO.** SPBC, 2002. http://www.comciencia.br/reportagens/petroleo/pet22.shtml Acesso em 07 set 2008.

FURTADO, A. T. **A trajetória tecnológica da PETROBRAS na produção offshore**. In: SBRAGIA, Roberto, MARCOVITCH, Jacques; VASCONCELLOS, Eduardo. Simpósio de Gestão Tecnológica (19:1996: São Paulo). XIX Simpósio de Gestão da Inovação Tecnológica: São Paulo, 1996: anais / organizado por Roberto Sbragia, Jacques Marcovitch e Eduardo Vasconcellos. São Paulo: USP/PGT/FIA/PACTO, 1996, p. 813-832.

FURTADO, A. T. **Mudança Institucional e Inovação na Indústria Brasileira de Petróleo.** Colóquio Internacional "Energia, Reformas Institucionales y Desarollo em América Latina", Universidad Nacional Autônoma de México – Université PMF de Grenoble, México, D.F., 5-7 noviembre 2003, p. 247 – 266. Disponível em http://www.depfe.unam.mx/p-cientifica/coloquio-erdal/10CaAndreFurtadoPortugLtt.pdf Acesso em 05 ago 2008.

HAIR, J.; ANDERSON, R.; TATHAM, R.; BLACK, W. **Análise Multivariada de Dados**. São Paulo: ARTMED. 2005.

MARZANI, B. S.; FURTADO, A. T.; GUERRA, S. M.. **Novo contexto de abertura do mercado brasileiro de Petróleo e os fornecedores locais: a criação do REPETRO**. 2o Congresso Brasileiro de P&D em Petróleo e Gás Natural. Salvador, BA: 2003.

MCT – Ministério de Ciência e Tecnologia. Disponível em http://www.mct.gov.br/ Acesso em 16 ago 2008.

OCDE - Organização para Cooperação e Desenvolvimento Econômico. **Manual de Oslo: Diretrizes para Coleta e Interpretação de Dados sobre Inovação.** OCDE, Eurostat, FINEP, 3º ed., 2004.

PEREIRA, N. M. **Fundos Setoriais no Brasil: Um Pouco da História.** Ciência e Cultura, vol.59 no.4. São Paulo, 2007.
PETROBRAS – Petróleo Brasileiro S/A. Disponível em http://www2.petrobras.com.br/portugues/ads/ads_petrobras.html Acesso em 23 jan 2009.
PETROBRAS - Petróleo Brasileiro S/A. Disponível em http://www2.petrobras.com.br/minisite/comunidade_cienciatecnologia/portugues/redes_tematicas.asp Acesso em 24 abr 2009.
SEGATTO**,** A. P. **Análise do Processo de Cooperação Tecnológica Universidade - Empresa: Um Estudo Exploratório.** (Dissertação de Mestrado). Universidade de São Paulo, Departamento de Administração da Faculdade de Economia, Administração e Contabilidade, 1996.
SEGATTO-MENDES, A. P. **Teoria de Agência à Análise de Relações entre os Participantes dos Processos de Cooperação Tecnológica Universidade-Empresa**. Universidade de São Paulo – USP. São Paulo: 2001. Tese de doutorado.
STAL, E. **A experiência da USP na Transferência de Tecnologia.** In: LAHORGUE, Maria Alice. Parques, pólos e incubadoras: instrumentos de desenvolvimento do século XXI. Anais. Brasília: ANPROTEC/SEBRAE, 2004, pág. 267-272.
VALLE, M. G.; BONACELLI, M. B. M.; SALLES FILHO, S. L. M. **Os Fundos Setoriais e a Política Nacional de Ciência, Tecnologia e Inovação.** XXII Simpósio de Gestão da Inovação Tecnológica. Salvador, BA: 6 a 8 de novembro de 2002.
VASCONCELOS M. C. R. L.; FERREIRA, M. A. T. **A contribuição da cooperação universidade/empresa para o conhecimento tecnológico da indústria.** Perspect. cienc. inf., Belo Horizonte, v. 5, n. 2, p. 167 - 182, jul./dez.2000.
VASCONCELOS, M. C. R. L. **Cooperação universidade/empresa na pós-graduação: contribuição para a aprendizagem, a gestão do conhecimento e a inovação na indústria mineira**. (Tese de Doutorado) Universidade Federal de Minas Gerais, Escola de Ciência da Informação, 2000.
VEDOVELLO, C. **Science parks and university-industry interaction: geographical proximity between the agents as a driving force**. Technovation.v.17. n.9.p. 491-502, 1997.
ZAMITH, R.; SANTOS, E. M. **O "diamante petroleiro" brasileiro em perspectiva**. In: Congresso Brasileiro de Planejamento Energético, 3, São Paulo, 1998. Anais. São Paulo, SEESP/SBPE/USP/UNICAMP/COPEE-UFRJ, 1998 p105-110.

THE ENTREPRENEURIAL UNIVERSITY IN RUSSIA: FROM IDEA TO REALITY

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Abstract
An entrepreneurial university plays an important role in realizing economic innovations and increasing global competitiveness and social welfare. Government needs to stimulate entrepreneurship education and encourage development of entrepreneurial universities. Incremental, sustainable, and long-term government initiatives consistent with the triple helix concept are necessary to modify the rigid higher education sector. The Russian model of an entrepreneurial university appropriate for the demands of the 21st century is explored. A case study of its leading university of technology in transition to an entrepreneurial university presents a few challenges faced and key lessons learned. The future of entrepreneurship education and entrepreneurial universities in Russia is discussed.

Keywords: entrepreneurial university, entrepreneurship education, concept of a university, higher education, russia.

KNOWLEDGE FLOW IN THE ACADEMIA- INDUSTRY COLLABORATION OR SUPPLY CHAIN LINKAGE? CASE STUDY OF THE AUTOMOTIVE INDUSTRIES IN THE JABABEKA CLUSTER

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Abstract
This paper focuses on the main question as to whether clustering enhances companies performance. It explores the various linkages of knowledge flow in the Jababeka Industrial Cluster, Indonesia. The research is based on semi-structured interviews and ethnographic fieldwork. Specifically there are two types of linkages in the Jababeka cluster. The first is the vertical hierarchical linkage cultivated by the Keiretsu between automaker and first tier suppliers, the second is the horizontal linkage between second tier and third tier industries. These linkages form clusters within clusters. However the horizontal linkage between academia and industry is limited and restricted.

Keywords: academia-industry collaboration; supply chain; automotive suppliers; knowledge flow; industrial cluster.

THE TRIPLE HELIX IN TEACHING ENGLISH AS A FOREIGN LANGUAGE: THOUGHTS FROM RUSSIA

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Abstracts
The authors base this paper on the principle that English language is unquestionably the global language of business, science and international politics, without knowledge of which one's ability to interact in the global innovation system is significantly reduced. The authors examine the Russian system of teaching English as a foreign language (TEFL), comparing the theory and practice – government policy ideals vs. the reality in universities. The authors' paper focuses on the Institute for Innovation at TUSUR, highlighting the recent advances made there in the field of TEFL in the wider context of the more 'traditional' approach to teaching English, the global language of innovation, found in most Russian higher education institutions. The authors find that this traditional approach is divorced from standard best practice acknowledged in 'western' countries and is detrimental to the progress of students. The authors demonstrate that increased interaction between universities, industry and government is of the utmost benefit to each and to society in terms of improving English language provision and, thereby, enabling fuller participation in the global innovation system. In addition to their conclusion, the authors make specific recommendations to government, business and universities in order to resolve the problems found to exist, strengthen that which is good, and move forward to an innovative approach to TEFL which embraces Triple Helix principles. Further research may be carried out in other developing countries where the teaching of English as a global language could benefit from being done in accordance with Triple Helix requirements.

Keywords: Triple Helix, higher education, Russia, English language, interaction processes

Introduction

It is generally accepted (Crystal, 2005) that the English language is the one global language in today's world; the language of business, science and international politics, without knowledge of which it follows that one's ability to interact in the global innovation system is significantly reduced. With globalization and the 'shrinking' of the world, the need to be able to communicate in English becomes greater and greater. It seems obvious, therefore, that English as a foreign language ought to be taught well in those countries which do not speak it as a native language. Yet it is the case in Russia that English is taught in higher education institutions only formally; evidence of which comes more than amply in the form of English language textbooks published by Russian universities and in the content of English language classes and local teachers' approach to them (Mitchell, 2011). Little or no account is taken of the fact that English may be studied in order to use it later in communication, again demonstrated by outmoded teaching practices and the emphasis on memorization of materials rather than communicative use of language (Gural & Mitchell, 2008).

Discussion

The Triple Helix model of innovation (Etzkowitz, 2008) has had a significant effect on the understanding and analysis of economic processes in Russia (Pudkova & Uvarov, 2009; Klemeshev & Gareev, 2008; Dezhina & Kiseleva, 2008). The financing of the so called 'innovation economy' of Russia has begun on a massive scale with impressive rhetoric from political leaders including former President Medvedev (Belton et al., 2010), yet we ignore – or are blind to – an obstacle which threatens to stop development in its tracks; it is the problem of communication, ever important in the globalized society in which we find ourselves. It was former West German Chancellor Willy Brandt who once observed: "If I'm selling to you, I speak your language. If I'm buying, dann mussen sie Deutsch sprechen!" To paraphrase Willy Brandt, if we are selling to the world, we must speak the world's language (Mitchell, 2011).

The fact that national educational standards were recently rewritten is of little importance given the absence of cardinal changes as regards content, approach, purpose and assessment in foreign language teaching. Tomusk (2004) notes that Russia is "not ready to admit that its higher education needs reform to restore its intellectual integrity and social and economic relevance." The problem is that despite acknowledgement of the need to reform, much is confined to rhetoric and not foreign language teaching has changed little. In addition, a lack of autonomy among Russian universities in relation to educational programs and their content continues to be a source of difficulties

(Bain, 2003; Suspitsyna, 2005). The vast majority of educational programs and courses, and their content, must be officially approved by the Ministry of Education. This hampers innovation and creativity, imbuing the higher education system with undue rigidness. It is important to trust to educators the business of educating.

In spite of advances in terms of understanding the importance of English language ability to Russia, e.g. the move from knowledge-based to competence-based standards, in many universities it is teacher incompetence that inhibits progress, not aided by the poor knowledge of those who determine what is taught. Ignorance and incompetence are difficult to root out when set in, but the Institute for Innovation's semi-autonomous status within TUSUR enables it to keep the vast majority of its education in-house, e.g. rather than being dependent on staff from TUSUR's centralized Department of Foreign Languages for teaching English, the Institute for Innovation has its own English language teaching staff, forty per cent of whom are native speakers, of whom 50% are qualified teachers of English (Institute for Innovation, 2012).

Through various initiatives, such as *English for All* (Institute for Innovation, 2012), the Institute for Innovation stimulates its students to continually develop their English language skills with a focus on their practical use in the global innovation economy. One of the first principles is that subjects such as, for example, international marketing, are better suited to being taught in English rather than Russian. There is little point teaching English as a separate, stand-alone, academic subject; if students find it a challenge to see its practical applications, they will not only suffer in terms of motivation, but will likely not see the subject as being worth a great deal of their time. By teaching relevant subjects in the medium of English we not only demonstrate the intrinsic relevance of the English language to their studies and future work, but also create in students practical knowledge and skills for future communication. If we expect innovators all over the world to be connected to the global innovation system, then it must be accepted that they have to be able to connect with each other with as few barriers in their way as possible.

The Institute for Innovation takes on board the Triple Helix principles of university-industry-government interaction and considers them indivisible from the educational process. Students are taught not only by professional educators, but also by local and foreign business leaders and government workers, both in Russian and – when possible – in English. Mitchell (2011) notes that, "Big business, of course, has long recognized the primacy of English in the global economy. Large companies in Russia have often required at least a minimal level of understanding upon hiring new recruits." Tomsk, as one of Russia' main innovation hubs, has plenty of innovative enterprises and a supportive regional government, thereby providing two spheres from which managers can be drawn and asked to contribute to the formation of the next generation of innovators. A considerable number of such persons have knowledge of English adequate enough to combine both innovation studies and the English language in a unified teaching process. Most importantly, all the actors involved understand, acknowledge and stress the importance of both innovation and English language skills to Russia's success in the global innovation economy.

The Russian government is "even prepared to send [federal officials] abroad to study in order to put Russia on a path toward an innovative future" (Bratersky & Odynova, 2011). The Institute for Innovation is not lacking in this respect either. The utility in sending students to international conferences, seminars and forums is deeply understood and financially supported from the Institute's coffers. Such experiences act as a stimulus to engage in the global innovation system, yet also underline the extent to which English language skills enable more effective involvement on a wide range of levels. By involving its students, from an early stage, in global Triple Helix processes they are inculcated with the understanding that being able to communicate in the world's only truly global tongue is of inestimable advantage not only to their own future success, but also the very success of the global innovation system and the Triple Helix.

A focus group with 2nd year students studying for bachelor's degrees in innovation studies at the Institute for Innovation was conducted in order to discover their opinions on the perceived connection between their English language learning and innovation studies. The focus group of ten students produced the following comments, with the number of students agreeing reported in brackets, regarding the system of teaching English as a foreign language practiced at the Institute. The comments have been abridged for clarity and to avoid being repetitious (e.g. where some students made very similar comments): "English language teaching at the Institute for Innovation is focused on communication skills rather than rote learning" (10); "teaching core subjects in English gives considerable advantages in terms of ability to understand important foreign literature" (10); "links with local business prove the importance of speaking English in the global innovation system" (8); "attending innovation conferences abroad reinforces the importance of being able to communicate in English" (8); "classes with native speakers add a new perspective to the importance of English as a global language" (7); "links with local government prove the importance of speaking English in the global innovation system" (7).

Analysis

Various important points emerge from this study. The first is that although, at first glance, knowledge of English may not seem particularly relevant to the Triple Helix and innovation in general, it is no less relevant than good eyesight is to an airplane pilot. It may indeed be viewed as a prerequisite to Triple Helix interaction on a global scale, even if not so important on the intra-national scale. This is possibly a point that escapes the attention of those for whom English is a native or state language, yet for those whose mother tongue is another language the benefits to being able to communicate in English cannot be over-emphasized.

In non-English speaking countries government must, therefore, in collaboration with universities and business, prioritize the harmonization of English language teaching within the university curriculum. It is essential to provide for English language learning based on communication, which can in turn be used to great effect within the Triple Helix context. Thus, English language teaching in many developing countries should be brought up to date with internationally understood norms.

It is evident that universities, bearing the major part of responsibility for learning, ought to integrate the educational process and particularly English language teaching into the Triple Helix alongside government and business, involving both of them in the process for the better development of the curriculum and better results in English language speaking ability. Only a unified approach to this issue can, as the Triple Helix demonstrates, provide a suitable lasting solution as far as Triple Helix actors are concerned. The results of the focus group clearly show that English language teaching can be done to great effect with an integrated concept.

Conclusion

To conclude, the authors feel that the inherent importance of communication to the Triple Helix and Triple Helix processes ought not allow us to ignore the imperative for entrepreneurial universities to be innovative in the development of such a sphere as English language teaching. Although, at first glance, language and communication may seem peripheral concerns compared to the interaction of universities, industry and government, they do in fact underpin it. This is particularly evident on the international level. The authors themselves are aware of situations in which, for example, papers on innovation have not been published due to problems concerning the level of English – if poor English skills hamper the dissemination of valuable knowledge and, subsequently, interaction between Triple Helix actors this itself should prove the necessity of improving English language teaching for the sake of Triple Helix effectiveness. It must be remembered that, on the global scale, Triple Helix interaction involves not only universities, industry and government in one given country, but also among different countries. The Triple Helix can never be truly global unless and until it makes full use of the world's global language. This is particularly so for developing countries, in which innovation and full communion with the world's advanced countries is disadvantaged partly due to a poor knowledge of English thanks to a low level of English language teaching. Further research can and should be conducted into the correlation between the ability to communicate in English and performance in the global innovation system, and the importance of English language skills on Triple Helix interactions internationally.

References

Bain O.B. (2003). University Autonomy in the Russian Federation since Perestroika. New York: RoutledgeFalmer, 247 pp.

Belton C., Clover C., Weaver C. (2010). Medvedev sees chance for new world order. http://www.ft.com/cms/s/0/81a03be0-7ac0-11df-8549-00144feabdc0.html#axzz1K35k7yd8 (Accessed 15.04.11)

Bratersky A., Odynova A. (2011). Bureaucrats to learn English. http://www.themoscowtimes.com/business/business_for_business/article/bureaucrats-to-learn-english/428568.html (Accessed 15.04.11)

Crystal D. (2005). English as a Global Language. Cambridge: Cambridge University Press.

Dezhina I.G., Kiseleva V.V. (2008). State, science and business in the innovation system of Russia. Moscow: IEPP, 227 pp.

Etzkowitz H. (2008). The Triple Helix. University – Industry – Government. Innovation in Action. Routledge, 238 pp.

Gural S.K., Mitchell P. (2008). The formation of a professional discourse based on the principles of interactive language teaching developed by Harvard professor Wilga M. Rivers, for non-language majors (the experience of Tomsk State University). Yazik i kultura №4 2008. Tomsk: TSU, pp. 5-10.
Institute for Innovation. (2012). List of staff. http://ui.tusur.ru/index.php/o-kafedre/prepodavateli (Accessed 19.04.2012)

Institute for Innovation. (2012). English for All. http://ui.tusur.ru/index.php/home/novosti/23-olimpiadu-po-anglijskomu-yazyku-dlya-vsekh-zhelayushchikh-ot-studentov-do-aspirantov-laborantov-i-doktorov-nauk (Accessed 19.04.2012)
Klemeshev T.P., Gareev T.P. (2008). Relations of the “University – Industry - Government”. Problemy upravleniya (RB), 2008, № 4, pp. 49-55.
Mitchell P. (2011). English for Innovators: The Importance of ELT Provision in an Innovation Economy. Innovatika – 2011: Materials of the VII All-Russian Conference of Students, Postgraduates and Young Researchers 28.04.2011. Tomsk: Tomskoe universitetskoye izdatel’stvo, pp. 36-40.
Pudkova V.V., Uvarov A.F. (2009). Elements of success for government, industry and university relations in Siberia. 7th Biennial International conference on University, Industry and Government Linkages, 7-19 June 2009, Glasgow, UK, pp. 48-50.
Suspitsyna T. (2005). Adaptation of Western Economics by Russian Universities: Intercultural Travel of an Academic Field, 168 pp.
Tomusk V. (2004). The open world and closed societies: essays on higher education policies ‘in transition’. New York: Palgrave Macmillan, 241 pp.

LEARNING STYLE ANALYSIS FOR STUDENTS OF BUSINESS MANAGEMENT STUDY PROGRAM OF TELECOMMUNICATION AND INFORMATICS TELKOM INSTITUTE OF MANAGEMENT

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Abstract

Institut Manajemen Telkom (IMT) is one of educational institution in Bandung. One of the study programme in IMT is Management of Telecommunication and Informatics Business. This Study Programme have more than 1000 student and it's become challenge to IMT to keep the quality of alumnus. The purpose of this research are to describe what is the most learning style that apply by student and also determine the best learning style that most suitable to achieve optimal academic achievement. Research method is descriptive research with operational variables consist of learning style and academic achievement. This research use Primary Data from quetionaire and secondary data from academic information system in IMT. Sample consist of 299 respondents and choose by stratified random sampling as a technique sampling. The result from data processing show that almost of student in Management of telecomunication and informatics business study programme apply Reflektor as learning style. It's mean that student prefer to learn the subject by comprehension process and need more time to understand. The comprehension process build with compile other information from outside that related with subject. Explanation and information in class will not help student to understand about the subject. Policy implication from this result is to design a new way of learning method that must show by faculty in IMT. A lecturer act as facilitator that not only talk and explain the theory in the class but also how to push their student to look and find another insight about the subject for example to give more assignment. The lecturer will give more explanation if the student need it. For IMT, maybe it will be good if mark in each subject are emphasized from assignment marking beside examination in last session. Another policy that must consider to apply is identified learning style for every student in IMT through counseling activity. Counseling department must be ready everyday to solve the problem of student learning which one can related with learning style for each student. Advice for further research are focus on spesific subject so we know which subject that need Activist, Reflector, Theorist or Pragmatist learning style.

Keyword : Learning style, Academic Achievement, Learning Method

INTRODUCTION

On July 12, 2008, STMB Telkom has changed its name into Institut Manajemen Telkom (Telkom Institute of management) by opening 5 (five) New Study Programs: Accounting, Communications, Visual Communication Design, Commerce Administration, and D3 Marketing. It is something that is proper to proud but also become a separate burden for IM TELKOM in order to constantly maintain the quality that so far has been reached, specially Program Studi MBTI (Business Management Study Program of Telecommunication and Informatics) indicated by Accreditation A. one of things that can be conducted by IM TELKOM is to constantly maintain the students' academic performance achievement as expected. In this process it is certainly needed an engagement both from IM TELKOM in providing means and infrastructures sufficiently in the learning style, lecturer acted as facilitator and student acted as main actor in the learning process.

Each student as an individual has certainly different learning style in understanding each subject they must take on. One's ability to understand and absorb a lesson is certainly different in its level. There are that of being quick, moderate and also very slow. Hence, they must frequently take on different ways in order to understand the same information or lesson. The less-suitable learning methods will lead to several problems, among other things:

a. Students who are enthusiastic to learn will easily despondent because hard work conducted didn't produce a bright output.
b. Students didn't know what to do.
c. Students learn seriously by they easily forget about all they have learned.
d. Students become to be stressed, restless and begin falling in ill because they are too tired learning with an unimpressed way.
e. Students take too long time for remembering what they have learned.

PROBLEMS

In order to support the enhancement of learning quality in the circle of IM TELKOM, specially Business Management Study Program of Telecommunication and Informatics (Program Studi MBTI), so it is necessarily known what learning style that is most suitable for achieving optimal academic performance and what learning style that is mostly applied by students. In this research using the data gathered from questionnaires concerning the tendency of learning style for students of IM TELKOM in Business Management Study Program of Telecommunication and Informatics. Output of this research is to identify if there is a certain learning style that must be applied by students to reach an optimal academic performance.

PURPOSES AND OBJECTIVES OF RESEARCH

Based on the background and problems mentioned above, so the objectives of this research are:

a. to identify the learning style that is mostly applied by the students of IM TELKOM.
b. to identify the learning style that is most suitable to achieve an optimal academic performance.

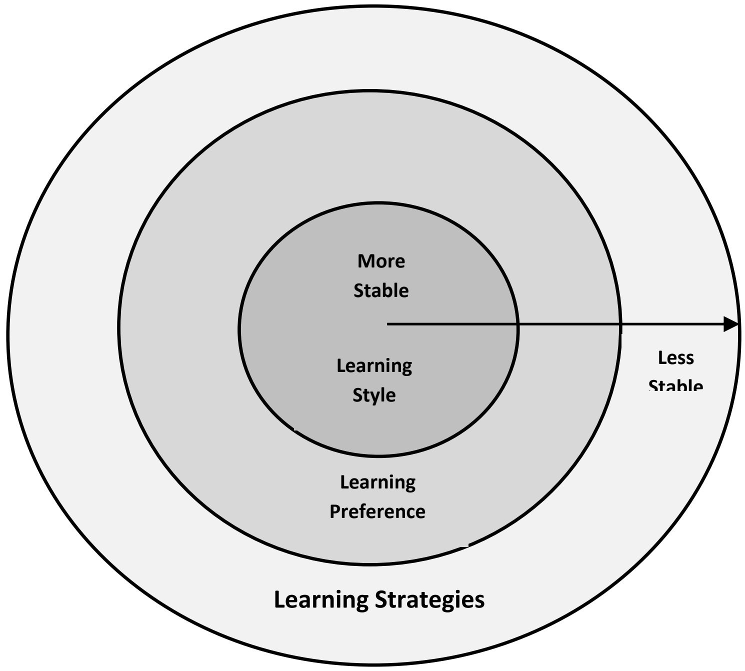
BASIS OF THEORY

Learning is a process where the knowledge is tried to create through transformation of experience. Learning indicates that a new cognitive structure and process is needed. In the learning, we must identify the difference of definition between 3 (three) things below (Sadler,1996:186):

1. *Learning style*
   Learning style is a special way and habit in obtaining knowledge, expertise or attitude through subjects or experiences.
2. *Learning Preference*
   Learning Preference is partiality for one special method in learning as compared with another. The preference can vary, depending on its task and context (atmosphere).
3. *Learning Strategies*
   Learning Strategies represent an action plan using knowledge, expertise or attitude we have obtained through lessons or experiences.

Sadler-Smith developed a model known as *Onion Ring Model* to represent the points mentioned above. *Onion Ring Model* can be seen in the following figure.

Three Layers of "*Onion Ring" Model*



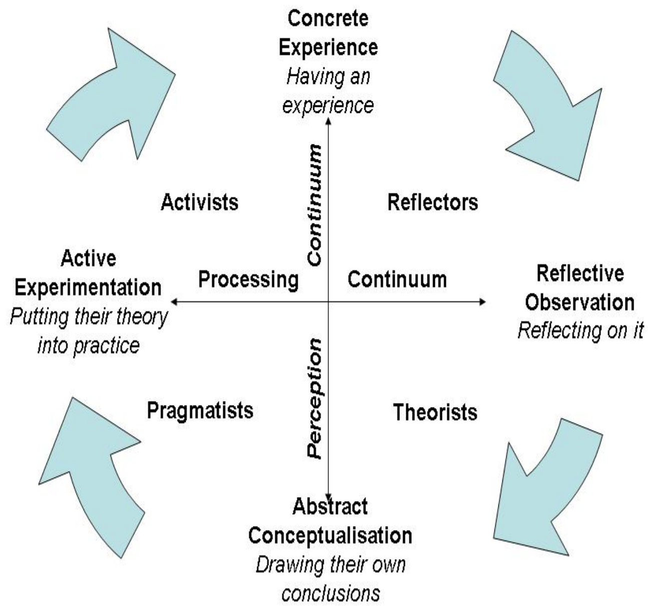
From the figure above we can see that a movement from center to more outer layer indicates a person moves from a more stable learning go to a less stable learning. It means that when we move outer, there is an environmental influence on our learning characteristic although the learning style we use is nearly the same.

During several decades backward, it has been carried out various researches associated with learning style. The needs for seeing one's learning style are:

1. To avoid an incompatibility between instructor (Lecturer) and Learner (Student). When Lecturer teaches a material with style they like, then it is not yet certain that all learners have identical learning style. What will happen is mistake in understanding what has been communicated.
2. Each instructor must help each his or her learner to know their learning style with an objective to build self-confidence and learning process can operates more effectively.
3. Although each person has a certain learning style, it doesn't mean that they can't afford to develop other learning style alternatives suitable to the material communicated. In the other hand, each person can do various strategies of learning style development in processing some information.

There are several theories describing about learning styles such as *the Dunn and Dunn Learning Styles Model, McCarthy's 4 MAT System, Myers-Briggs Learning Styles Indicator, Kolb's Learning Styles* and *Honey & Mumford Learning Styles.* Honey and Mumford have created have few differences of meanings. They also said that the people like different learning methods, depending on the situation and experience level. So they move between four types of learning styles and didn't only rivet on one type of learning style. The following figure is Model revealed by Honey and Mumford.

Honey and Mumford's Learning Style Model



As for the definitions of each learning style type above are:

a. Reflector
The learning style type of Reflector more likes to learn from activities enabling them to see, think and evaluate what is happening, such as the use of journal and brainstorming. The lecturer will help if needed an expert's explanation and analysis.
b. Theorist
The learning style type of Theorist more likes to solve problems with clear stages, such as teaching by lecturers, analogy, system, case study and model. Speaking with an expert doesn't generally help.
c. Pragmatist
The learning style type of Pragmatist more likes directly to do a concrete practice for new knowledge obtained, such as laboratory, field work, and observation. In addition, also feedback, a real relationship between task and problem.
d. Activist
The learning style type of Activist likes a challenge, new experiences, problem solving, and small group discussion.

RESEARCH METHOD

Research method used is descriptive one conducted through a survey. This research tries to gather facts, to descript, to analyze and to interpret the data into some clear and appropriate information. The information obtained is a result of a study systematically and factually concerning the behaviors of the students of IM TELKOM.

OPERATING OF RESEARCH VARIABLES

The variables in this research include the variables required to determine the students' learning style types that will then associated with academic performance. The variables used are as shown in the following table.

Operating of Research Variables

VARIABLES	SUB VARIABLES	DATA SOURCES	RESPONDENTS
LEARNING STYLE	Activist	Primary Data	Students of Business Management Study Program of Telecommunication and Informatics of Telkom Institute of management
	Reflector		
	Theorist		
	Pragmatist		
ACADEMIC PERFORMANCE	The Entire IP/IPK	Secondary Data	
	The Average Grade Of Qualitative Subjects		
	The Average Grade Of Quantitative Subjects		

SAMPLING TECHNIQUE

In this research the samples taken is based on Proportional Stratified Random Sampling, taking a sample for each strata based on the number of each strata's population. The population is grouped into sub-populations based on certain criteria owned by population element. Of each population, furthermore it is taken as member randomly by proportional composition.

The reasons for selecting this sampling technique are:

1. Not only representing the entire population, but also existing small groups (subgroups).
2. This method will generally be more precision (appropriate) than *simple random sampling.*
3. This technique is used when the population has inhomogeneous members or elements

The strata in this research is established based on the value of Performance Index/Cumulative Performance Index (IP/IPK) obtained by students. The number of samples taken is as many as 299 students with the following terms:

The Number of Samples Based on IP/IPK

NO	CATEGORY	IP/IPK	NUMBER OF SAMPLES
1	Very Satisfactory	3.51 – 4,00	41
2	Satisfactory	2.76 – 3,50	179
3	Less Satisfactory	2.00 – 2,75	69
4	Unsatisfactory	0.00 – 1,99	10
			299

DATA COLLECTING TECHNIQUE

Data collecting technique in this research has been carried out through the two ways:

1. Primary Data Collecting Technique
   Primary data are data gathered from first source where in this research it has been conducted by filling in the questionnaires.
2. Secondary Data Collecting Technique
   In gathering this secondary data, the writer found from the seeking of academic performance data in the forms of Performance Index and Cumulative Performance Index from Telkom Institute of management.

DATA PROCESSING TECHNIQUE

In order to process the gathered data, firstly the items of questions in the questionnaires have been grouped previously according to the existing learning style type with the following terms:

Classifications of Question Items Based on The Learning Style Types

LEARNING STYLE ACTIVIST	LEARNING STYLE REFLECTOR	LEARNING STYLE THEORIST	LEARNING STYLE PRAGMATIST
Item No. 2	Item No. 7	Item No. 1	Item No. 5
Item No. 4	Item No. 13	Item No. 3	Item No. 9
Item No. 6	Item No. 15	Item No. 8	Item No. 11
Item No. 10	Item No. 16	Item No. 12	Item No. 19
Item No. 17	Item No. 25	Item No. 14	Item No. 21
Item No. 23	Item No. 28	Item No. 18	Item No. 27
Item No. 24	Item No. 29	Item No. 20	Item No. 35
Item No. 32	Item No. 31	Item No. 22	Item No. 37
Item No. 34	Item No. 33	Item No. 26	Item No. 44
Item No. 38	Item No. 36	Item No. 30	Item No. 49
Item No. 40	Item No. 39	Item No. 42	Item No. 50
Item No. 43	Item No. 41	Item No. 47	Item No. 53
Item No. 45	Item No. 46	Item No. 51	Item No. 54
Item No. 48	Item No. 52	Item No. 57	Item No. 56
Item No. 58	Item No. 55	Item No. 61	Item No. 59
Item No. 64	Item No. 60	Item No. 63	Item No. 65
Item No. 71	Item No. 62	Item No. 68	Item No. 69
Item No. 72	Item No. 66	Item No. 75	Item No. 70
Item No. 74	Item No. 67	Item No. 77	Item No. 73
Item No. 79	Item No. 76	Item No. 78	Item No. 80

After doing classification, and then it is given a grade for each answer in each its number. When the answer given “Very Agree” and “Agree” then scored 1. Whereas the number with answer “Disagree” and “Very Disagree” didn’t given score. Hence it will be obtained total value for each learning style type. The next step is to determine learning style type for each respondent.

ANALYSIS

1. Student’s Learning Style Type Generally

Based on the result of data processing, it has been obtained a tendency of learning style type applied by students of Business Management Study Program of Telecommunication and Informatics as shown in table 4.1. from the data presented in the table, it has been seen that the combination of learning style type applied by students highly varied. But after making its percentage, in fact that about 35.13% of students applied learning style Reflector. And then 18.35% of students applied main learning style Reflector with Theorist as supporting learning style. Whereas the remain 46.52% has highly various learning style types. The students with learning style type Reflector indicate that they can see something with different perspectives or viewpoints. They participated actively to seek other information from various sources such as references of books, journals, articles, and other sources that can provide some information required. In completing a given task, they more like working in a group and opening to the presence of feedback. Whereas the supporting learning style Theorist indicates that they see something as a part of system, concept or theory learned. They like to explore an analytic model and spending time to think rationally and objectively about how something can occurs.

Associated with the subjects existing in the curriculum of Business Management Study Program of Telecommunication and Informatics currently, the students will more easily understand the lecture materials when they participate actively in seeking other information relating to the subjects followed. It means that they not only learn from a lecturer’s explanation in the classroom. In this case it is needed a participation of lecturer to direct the students such as giving some tasks with the use of reference beyond the book reference obliged to use and setting up group discussions. The providing of feedback should be in routines to conduct by lecturer when the students have problems relating to the material in question.

Learning Style Types of The Students of Business Management of Telecommunication and Informatics

Learning Style		Percentage
Main	Supporting	
R		35.13%
R	T	18.35%
A		5.38%
T	R	5.38%
RT		4.75%
R	A	4.43%
A	R	3.48%
T		3.16%
R	P	2.53%
P		2.22%
AR		1.90%
T	P	1.27%
AP		1.27%
R	TP	1.27%
P	R	0.95%
RP		0.95%
RP	T	0.95%
T	A	0.95%
A	T	0.63%
ARP		0.63%
P	A	0.63%
P	RT	0.32%
RTP		0.32%
A	P	0.32%
ARP	T	0.32%
AT		0.32%
RTP	A	0.32%
A	RT	0.32%
ATP		0.32%
RT	A	0.32%
RT	P	0.32%
TP	R	0.32%
TP		0.32%

2. Students' Learning Style Type Based on IP/IPK

In this research, the population is divided into sub-populations based on the grades of IP/IPK obtained by the students. After the students have been grouped based on the grades of IP/IPK so it is obtained the percentage of learning style as indicated in the following table.

Learning Style Type Based on the Students' IP/IPK

	VERY SATISFACTORY			SATISFACTORY			LESS SATISFACTORY			UNSATISFACTORY		
LEARNING STYLE	Main	Supporting	Percentage	Main	Supporting	Percentage	Main	Supporting	Percentage	Main	Supporting	Percentage
	R		32.56%	R		40.74%	R		26.03%	A		18.18%
	R	T	16.28%	R	T	21.69%	R	T	12.33%	R		9.09%
	A		6.98%	T	R	5.29%	A		6.85%	R	P	9.09%
	A	R	6.98%	A		3.70%	P		5.48%	R	T	9.09%
	R	A	6.98%	A	R	3.70%	R	A	5.48%	RT		9.09%
	R	P	6.98%	R	A	3.70%	RT		5.48%	R	TP	9.09%
	RT		6.98%	RT		3.70%	AP		4.11%	AR		9.09%
	T	R	6.98%	T		3.17%	R	TP	4.11%	A	R	9.09%
	P	RT	2.33%	AR		2.65%	RP	T	4.11%	T	R	9.09%
	RTP		2.33%	P	R	1.59%	T		4.11%	TP		9.09%
	T	P	2.33%	P		1.59%	T	A	4.11%			**100.00%**
	T		2.33%	RP		1.59%	T	R	4.11%			
			100.00%	A	T	1.06%	R	P	2.74%			
				R	P	1.06%	T	P	2.74%			
				ARP		1.06%	A	RT	1.37%			
				A	P	0.53%	ATP		1.37%			
				AP		0.53%	P	A	1.37%			
				ARP	T	0.53%	RT	A	1.37%			
				AT		0.53%	RT	P	1.37%			
				P	A	0.53%	TP	R	1.37%			
				RTP	A	0.53%			**100.00%**			
				T	P	0.53%						
						100.00%						

Based on the table above it has been seen that for the students with the very satisfactory, satisfactory and less satisfactory IP/IPK have largest percentage for learning style type Reflector. And then followed by learning style type as mixed between Reflector as main learning style and Theorist as supporting learning style. About 32.56% of students with very satisfactory IP/IPK have learning style Reflector and 16.28% of students applied the combination of learning style Reflector (main) and Theorist (supporting). Whereas for the students with satisfactory IP/IPK, as many as 40.74% have learning style Reflector and 21.69% combination of Reflector (main) and Theorist (supporting). For the students with less satisfactory IP/IPK have little lower percentage: 26.03% Reflector and 12.33% combination of Reflector (main) and Theorist (supporting).

A different thing is indicated by the students with unsatisfactory IP/IPK. The highest percentage is that 18.18% of students shows learning style Activist. Whereas the remain have been distributed evenly for different learning style types, the students with learning style Activist indicate that they more relay on their intuition as compared their logic. They used the analytic results from others and they like a practical approach. In resulting in an idea, it doesn't regard a limitation concerning both polices and structures. Someone with activist type can afford to learn maximally when the learning atmosphere only contains a lecturer's explanation and statement. They didn't like if they must analyze in details the various data, working alone, repeating the same activities, they must follow a lecturer's instruction carefully with few opportunities for themselves initiatives.

3. Students' Learning Style Type Based on The Properties of Subjects

The subjects being in the curriculum of Business Management Study Program of Telecommunication and Informatics will be grouped based their properties. There are two groupings of subjects: subjects tending to be qualitative and subjects tending to be quantitative.

The subjects in the Business Management Study Program of Telecommunication and Informatics are highly dominated by the subjects tending to be qualitative about 68%. Whereas the quantitative subjects are only about 32%. For each group of subjects above, and then it is determined a performance achieved by each student. After that it will compared between performance resulted in learning style type applied by each student.

Table of Learning Style Types Based on The Average Grade of

Subjects Tending to be Qualitative

	VERY SATISFACTORY			SATISFACTORY			LESS SATISFACTORY			UNSATISFACTORY		
	Main	Supporting	Percentage	Main	Supporting	Percentage	Main	Supporting	Percentage	Main	Supporting	Percentage
LEARNING STYLE	R		33.33%	R		35.50%	R		28.36%	AR		20.00%
	R	T	23.08%	R	T	20.00%	R	T	11.94%	A		20.00%
	A	R	7.69%	RT		6.00%	R	A	5.97%	T	R	20.00%
	R	P	5.13%	T	R	5.50%	T	R	5.97%	R	T	10.00%
	RT		5.13%	A		4.50%	A		4.48%	R		10.00%
	T	R	5.13%	R	A	4.50%	T		4.48%	R	TP	10.00%
	T	P	2.56%	T		3.00%	RP	T	4.48%	RT		10.00%
	AR		2.56%	R	P	2.50%	A	R	2.99%			**100.00%**
	P	RT	2.56%	AR		2.50%	R	TP	2.99%			
	A		2.56%	RP		2.00%	RT		2.99%			
	RTP		2.56%	A	R	2.00%	P	T	2.99%			
	T		2.56%	P		1.50%	AP		2.99%			
	P		2.56%	P	R	1.50%	A		2.99%			
	R	A	2.56%	ARP		1.00%	P	T	1.49%			
			100.00%	T	A	1.00%	TP		1.49%			
				RP	T	1.00%	P	A	1.49%			
				T	P	1.00%	P	R	1.49%			
				RTP	A	0.50%	RT	A	1.49%			
				ARP	T	0.50%	T	P	1.49%			
				R	TP	0.50%	R	P	1.49%			
				RT	P	0.50%	ATP		1.49%			
				AP		0.50%	TP	R	1.49%			
				A	T	0.50%	A	T	1.49%			
				A	P	0.50%	T	A	1.49%			
				A	RT	0.50%			**100.00%**			
				P	A	0.50%						
				AT		0.50%						
						100.00%						

Based on the table above it has been seen that the students who have the average grade of qualitative subjects with very satisfactory category. Satisfactory and Less Satisfactory categories largely applied learning style Reflector. Whereas for the second rank the largest percentage applied main learning style Reflector combined with supporting learning style Theorist. About 33.33% of students with the average grade in the Very Satisfactory category have learning style Reflector and 23.08% have learning style Reflector with Theorist as supporting learning style. Whereas the students with the average grade in the Satisfactory category about 35.50% with learning style Reflector and 20% have a combination of learning style Reflector and Theorist. Approximately 28.36% of students with the average grade in Less Satisfactory category have learning style Reflector and 11.94% have main learning style Reflector with supporting learning style Theorist. For the students with the average grade in Unsatisfactory category applied learning style that is little different where about 20% have learning style Activist Reflector, 20%

learning style Activist and the remain 20% applied learning style Theorist with supporting learning style Reflector.

From here we can see that really the learning style have been proved to be not too influential and can be made the only factor in determining the academic performance achieved by the students. This has been verified by the various learning style in each category of student's academic performance and learning style Reflector becoming majority learning style has been also distributed evenly for each category except for the Unsatisfactory category. It means that there are other factors having influence on the student's performance such as physical, psychological, and social factors.

a. Physical Factor
   This factor includes health such as to be tired quickly, easily sleepy and less enthusiastic in learning.
b. Psychological Factor
   1) Intellective Factor: perspicacity and talent viewed from attention level, rapidity in learning and absorbing the materials, frequency of learning exercise.
   2) Non-Intellective Factor: the elements of other personalities such as interest, motivation, emotion.
c. Social Factor
   1) Family circle: parents' attitudes, family's economic conditions
   2) School circle: learning-teaching method, lecturer's capability
   3) Around circle: social intercourse, organizational activities.

   The factors mentioned above are points that are necessarily considered as determinants of student's academic performance.

Table of Learning Style Types Based on The Average Grade of

Subjects Tending to be Quantitative

	VERY SATISFACTORY			SATISFACTORY			LESS SATISFACTORY			UNSATISFACTORY		
LEARNING STYLE	Main	Supporting	Percentage	Main	Supporting	Percentage	Main	Supporting	Percentage	Main	Supporting	Percentage
	R		32.94%	R		34.51%	R		32.43%	R		31.82%
	R	T	24.71%	R	T	18.58%	R	T	17.57%	T	R	11.36%
	A		8.24%	T	R	6.19%	R	A	5.41%	AR		9.09%
	RT		7.06%	A	R	4.42%	T	R	4.05%	R	A	9.09%
	A	R	4.71%	AR		3.54%	RT		4.05%	R	T	9.09%
	T	R	4.71%	RP		3.54%	A		4.05%	AR		4.55%
	R	P	3.53%	RT		3.54%	RP	T	4.05%	T		4.55%
	T		3.53%	R	A	2.65%	T		2.70%	R	TP	4.55%
	R	A	3.53%	P	R	2.65%	R	P	2.70%	P		4.55%
	P		2.35%	A		2.65%	T	A	2.70%	T	A	2.27%
	T	P	1.18%	T		2.65%	AP		2.70%	RT		2.27%
	P	RT	1.18%	R	P	1.77%	P	T	2.70%	TP		2.27%
	P	R	1.18%	AP		1.77%	ARP		1.35%	P	A	2.27%
	RTP		1.18%	RP	T	1.77%	RP		1.35%	ATP		2.27%
			100.00%	T	P	1.77%	AR		1.35%			**100.00%**
				A	T	1.77%	P	T	1.35%			
				RTP	A	0.88%	ARP	T	1.35%			
				R	TP	0.88%	R	TP	1.35%			
				ARP		0.88%	RT	P	1.35%			
				A	P	0.88%	T	P	1.35%			
				A	RT	0.88%	RT	A	1.35%			
				AT		0.88%	P	A	1.35%			
				P		0.88%	TP	R	1.35%			
						100.00%			**100.00%**			

Based on the table above it has been seen that the largely students who have both the average grade in Very Satisfactory, Satisfactory and Less Satisfactory categories and Unsatisfactory together applied learning style Reflector. 32.94 % of students with the average grade in the Very Satisfactory category have learning style Reflector and 24.71 % applied main learning style Reflector with its supporting is

Theorist. Whereas the students with the average grade in the Satisfactory category, about 34.51% of students applied learning style Reflector and 18.58 % have a combination of learning style Reflector and Theorist. 32.43% of students with the average grade in Less Satisfactory category have Learning Style Reflector with 17.57% have learning style Reflector and Theorist. Likewise the students having the average grade in Unsatisfactory category largely applied learning style Reflector that is about 31.82 % and 11.36% combination of Theorist and Reflector.

For the quantitative subjects have uniformity of learning style majority for each category: learning style Reflector and Reflector Theorist. It means that the student's learning style can't be used as a main reference in determining academic performance. The learning style acted as one factor and not become the only determinant of student's success in achieving the desired academic performance. And then we have to consider other influential factors such as physical, psychological and social circle in addition to the student's learning style only.

CONCLUSIONS

From the results of data processing, it has been obtained some information that:

1. The learning style that is largely applied by the students of IM TELKOM of Business Management Study Program of Telecommunication and Informatics is learning style Reflector. It means that the students of IM TELKOM more like to learn the materials obtained through an understanding process taking time. This understanding is built by trying to gather some information – other information relating to the material in addition to the lecturer's explanation in the classroom. They like when they can mutually exchange of thoughts with others for enhancing their insights concerning something.
2. The learning style not the only determinant of student's academic performance. There are other influential factors: health, psychological factors such as perspicacity, motivation and emotion, and social circle factor.

SUGGESTIONS

The information obtained from this research can be used as inputs for:

1. Helping the students in understanding the learning style they have applied in a learning-teaching process through counseling activity. Counselor must be trained to understand about characteristic for each learning style and also capable to give advice about how to absorb a lesson. The final goal from this counseling is to direct the student achieve best academic performance.
2. Assisting the lecturers in considering the alternatives of teaching methods that more vary for example case study, discuss about a lesson in small group, simulation, feedback, etc. The Lecturer must be given information that their student have various learning styles and different level to understand the subject. The institution can ask them to follow training for improvement teaching method effectiveness.
3. Conducting a further and more specific research to identify the tendency of student's learning style in each subject in IM TELKOM. This suggestion rise based on condition that every subject is emphasized to achieve specific and different competencies.
4. The samples used for the further research would be more uniform primarily for class that has justly completed the subjects coming to the object of research.

REFERENCES

Basuki, Sulistyo. 2006. ***Metode Penelitian.*** Wedatama Widya Sastra. Jakarta. Indonesia.

Cooper. Donald R., and Pamela S. Schindler. 2006. ***Business Research Methods,*** 9th edition. McGraw-I-fill Companies, Inc. New York.

Cage. N.L. and David C Berliner. 1998. ***Educational Psychology***, *Houghton* Mifflin Company. Boston. New York.

Kolb. David A. 1984. ***Experiential Learning: Experience as the Source of Learning and Development,*** Prentice-Hall, Inc.. Englewood Cliffs. New York.

Makmun. Ahin Svamsuddin Prof. DR. MA. 2007. ***Psikologi Kependidikan.*** PT. Remaja Rosdakarva. Bandung. Indonesia.

Masyhuri. Ir. Ir. MP.. dan Drs. Zainuddin MA. 2008. ***Metodologi Penelitian, Pendekatair Praktis dan Aplikatif***. PT.

Relika Aditama. Bandung.
Smith. Donna M.,and David A. Kolb. 1986. ***The User's Guide .for the Learning-Style Inventory: Al Manual fin-Teachers and Trainers.*** Mr. Ber & Company. Boston.
Walter Gordon A. and Stephen 1 Marks. 1981. ***Experiential Learning and Change.*** John Wiley & Sons. New York.
www.Businessball.com
www.peterhoney.com.

ANALYSING UNIVERSITIES' CONTRIBUTION IN LATECOMER CATCH-UP: THE ADDED-VALUE OF THE 'FUNCTIONAL' SYSTEM OF INNOVATION APPROACH

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Abstract
In the literature, investigation on the specific role of universities in technological innovation has been conducted from various perspectives: the organizational perspective using the entrepreneurial university approach, as a two-way relationship with firms using the university-industry links approach, as a three way relationship with firms and government agencies using the triple helix approach and finally in terms of multiple relationships with various actors using the system of innovation approach. Compared to the other approaches, the system of innovation approach is the least developed for this purpose. This article proposes that there is added value and novelty in using the system of innovation approach, particularly through its analysis of 'functions', to investigate the role of universities in innovation systems, especially in the context of latecomer catch-up. The proposition is based on insights derived from a critical review of the literature and an exploratory empirical work conducted by the author. The review covers a combination of literatures on system of innovation (specifically the technological system framework and recent advances in the analysis of functions) and the role of universities in technological innovation, with a relatively older literature by Perez and Soete in 1988.

Keywords: Universities, system of innovation, latecomer, catching-up, technological system, functional analysis

1. Introduction

A common concern amongst policymakers in latecomer countries[2] is that their universities is vastly underutilized, even though potentially they are powerful vehicles for enabling these countries to build national capacities in the development of science, technology and innovation. This has led to the emphasis on the promotion of new roles by universities, such as conducting industrial R&D, technology parks, business incubator facilities, university patenting and spin-off firms. Recognition of these new roles were then coupled with the problems faced by universities in the latecomer countries to assume such roles, especially regarding inadequate university-industry linkages in making use of universities' contributions, plus the weaknesses of the universities themselves in terms of research incentives, infrastructure, location and curricula development: This has led to the various recommendations for investing more resources to enable these new roles to flourish (Juma and Lee, 2005, pp.93 - 98)

Interestingly, one idea behind such policy recommendation is the view that if these new roles can be affectively implemented by universities, it could then open up higher opportunity for latecomer countries to participate in the development of new emerging technologies and, and hence to take an active part in exploiting the benefits of the global knowledge economy (Juma and Clark, 2002). In other words, universities can play an important role in the strategy of catching-up by providing the basis in which latecomer countries could enter early in the development of new technologies. With this policy interest in mind, interesting question ensues: "To what extent can universities in latecomer countries contribute to this catching-up strategy of early entry? How best can we determine their contributions?"

In line with this policy concern, this paper attempts to provide some insights on these questions through a critical review of the literature together with some findings from an empirical research. The literature review traces related theoretical idea from (what I considered) as the seminal article on the catching-up strategy of early entry by Perez and Soete (1988) - in which the authors propose that an effective catching-up strategy involves being in a position where

[2] Latecomer refers to those countries that arrive late on the industrial scene. In this article, it is interested in latecomer countries from the mid 20th century that has less developed industrial infrastructure than early-industrialised countries.

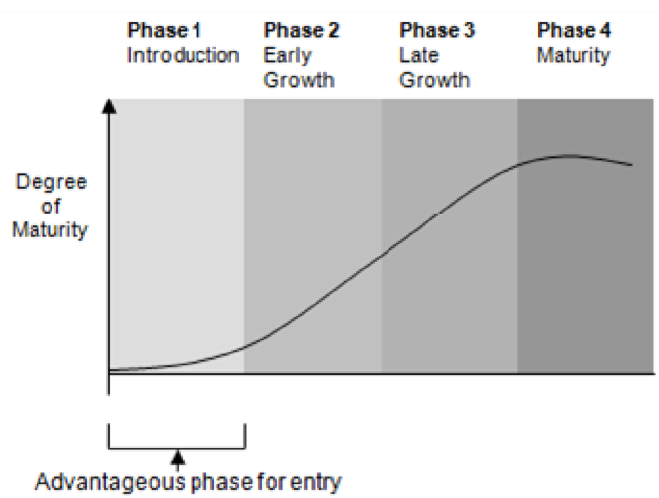
latecomer countries can take advantage of the temporary windows of opportunity created by the transition to new (or emerging) technologies. One of their arguments is that universities in latecomer countries can be used to exploit windows of opportunity associated with scientific and technological knowledge that are available during this early phase of a technology's development. Using this early entry literature as its baseline, the paper subsequently demonstrates that the system of innovation approach can be usefully employed to investigate the role of universities in early entry – particularly through the use of the technological systems framework and the framework's more recent analytical ideas on functional analysis. Insights from an exploratory empirical research are then used to highlight actual findings to support this proposition.

This paper consists of six sections. After this introduction, the initial sections will cover the two-part literature review of the literature – first, on early entry as a catching-up strategy and its connection to the development of innovation system, and second, more specifically on the role of universities in early entry. Based on this literature review, my proposition in applying the 'functional' system of innovation approach to investigate the contribution of universities in the catching-up strategy of early entry is elaborated in Section 4. Section 5 supports this further through the results of an actual empirical research. The paper ends with a short conclusion and some suggestions on the ways forward.

2. Early entry as a catching-up strategy and the development of innovation system

In their 1988 paper entitled 'Catching-up in new technology: entry barriers and windows of opportunity', Perez and Soete (1988, pp.459-460) propose that the catching-up process will be more effective if firms in latecomer countries enhance their capacity in generating and improving technologies by participating in the process of developing the technology during the early stages of its life cycle: "A real catching-up process can only be achieved through acquiring the capacity for participating in the generation and improvement of technologies as opposed to the simple 'use' of them". This means being able to enter either as early imitators or as innovators of new products or processes". This can be illustrated conceptually as firms in latecomer countries entering the development of the technology during the 'introduction phase' of the technology's life cycle (see Figure 1). They used the term "early entry" for this catching-up strategy (p.475).

Figure 1: Conceptualisation of early entry within a technology's life cycle



Source: Adapted from Perez and Soete, 1988: 471

Here, early entry is considered as one alternative catching-up strategy by which latecomer countries may acquire and apply the capacity to participate in generating and improving technologies. It involves developing innovation capacity at the early stages of the technology's lifecycle before it undergoes significant commercialisation. This contrast with the much more common strategy of entering into the use of technologies once they are matured (See the 'product life cycle theory' by Vernon, 1966 and the 'flying geese model' by Akamatsu, 1962) - or the strategy of progressively building deeper innovative capability from the growth phase of the technology life cycle i.e. along the lines of the 'acquisition-assimilation-improvement sequences' (Kim, 1997) or 'reverse product cycle' (Hobday, 1955) approach popularly associated with the East Asian tiger economies.

The idea of early entry by Perez and Soete was motivated mainly by their concern that most developing countries continue to face enormous difficulties in their efforts to industrialise, and that the structural gap with industrialised countries remains wide (Perez and Soete, 1988, p.458). Thus, they argued that firms in developing countries should exploit the 'windows of opportunity' that are available during the early phase of the technology's life cycle to increase the pace of the catching up process. These windows of opportunity, they suggest, include free flow of technological knowledge, reduced competition due to lock-in of leaders in past technologies and lower investment in expensive and standardised capital goods (For elaboration of the 'windows of opportunity' concept, see: Perez and Soete, 1988, pp.464 – 475 and Perez, 2001)

It is important to understand that these windows of opportunity are based on the authors' ideas of the 'costs of entry' (Perez and Soete, 1988, pp.464-475) and how these costs characterise different phases in the technology life cycle. Using simple world logic, Perez and Soete argued that given appropriate conditions, the 'introduction' and 'maturity' phases provide the most easily attainable threshold conditions for new entrants, although they have radically different costs and requirements. In the introduction phase, entrants may have little capital and experience - but with relevant scientific and technical knowledge plus an adequate provision of some locational advantages (which they referred as "externalities"), they can still enter the market at the early stages of the technology. In addition, Perez and Soete perceived that the requirements for entering the introduction phase are relatively low with regard to experience or managerial capability, which makes this strategy ideal for latecomer countries.

Entry in the mature phase, on the other hand, depends on traditional comparative and locational advantages. Here, the authors were of the opinion that mature products are precisely those whose technological dynamism is exhausted, and this choice implies a clear risk of becoming 'fixed' within a low wage, low growth, development pattern (Perez and Soete, 1988, p.459). Finally, entry in the growth phases provides fewer opportunities for catching-up due to the high experience and skills threshold. Thus, according to the authors "this [i.e. the growth phases] is therefore no time for new entrants" (Perez and Soete, 1988, p.473). From this standpoint, they considered that a real catching-up process could only be accomplished through early entry, i.e by reaping the long term advantages of generating and improving technologies during the 'introduction' phase of the technology's life cycle.

This idea of a catching-up strategy as being more about the process of mastering the way of doing things and creative modification are also recognised and discussed in later years by authors in the system of innovation literature. Chris Freeman (2002), for instance wrote about the relevance of innovation systems for economic growth rates, based on key catching-up cases that occurred in the last two centuries: namely the cases of Britain in the 18th century, the United States in the second half of the 19th century and the East Asian Tigers in the 20th century. In the conclusion to his paper, Freeman asserts that the national differences in catching-up were attributable to the evolution of strong innovation systems.

Freeman's view is in line with other contemporary thinking on the strategies for catching-up. Nelson (2004, p.370) used a historical argument for highlighting Christopher Freeman's proposition that Friedrich List had something like a national innovation system in mind when he was writing about what 19th century Germany needed to do to catch up with Great Britain. Nelson also returns the reader back to Bell and Pavitt's (1993) suggestion about the importance of building a host of domestic institutions for effective catch-up. Mytelka (1993, 2000, 2004) proposed similar ideas based on newer empirical evidence (within the 20th and 21st century) and on the basis of this, justified why the catching-up process needs to focus on the development of a local innovation system. This includes the importance of developing a range of learning organisations within a broader institutional context and developing various types of knowledge networks to enable innovation. Both authors also converge in their opinion that such innovative strategy is particularly relevant for the more challenging requirements for catching-up in the 21st century (Nelson, 2004: 371; Mytelka, 2004) - particularly in the area of new generic technologies such as ICT, biotechnology and new energy technologies. More recently, Jacobsson and Bergek (2006) were more specific in suggesting that the formation of a new innovation system for catching-up requires three structural processes at the system level: entry of firms and other organisations, formation of networks, and institutional alignment. In order to have a better chance for catching-up, these structural processes need to cater to seven system functions requirements: knowledge development and diffusion, influence on the direction of search, entrepreneurial experimentation, market formation, legitimation, resource mobilisation and development of positive externalities.

Unlike Perez and Soete, the focus of the system of innovation authors was not on catching-up by exploiting windows of opportunity, but rather on building strong innovation system to sustain latecomer countries' abilities to develop, diffuse and use technologies in the long run. However, I would suggest that the two sets of ideas complement rather than oppose each other. The windows of opportunity idea proposed by Perez and Soete places the emphasis that the establishment of an innovation system during the introduction phase of a technology's life cycle is comparatively advantageous compared to later phases. Entering in the introduction stage gives not only more time to develop innovation system, but also enhances this development through the existence of window of opportunity.

3. The role of universities in early entry

As already mentioned in earlier, Perez and Soete perceived the requirements for early entry to be relatively low in terms of capital, experience and managerial capability, which makes this catching-up strategy ideal for latecomer countries. Two problems remain: the need for a high level of externalities and the need for scientific and technical knowledge during the emerging phase of a technology's life cycle. Perez and Soete (1988, p.476) simplified their examination, dismissing the externality barrier by assuming that government action would eventually compensate for the lack of locational and infrastructural advantages. This allowed them to concentrate on the types of barriers created by scientific and technological knowledge.

Here Perez and Soete suggest that universities might be the actors able to overcome the barriers associated with scientific and technical knowledge as they are the actors with the best position to exploit the window of opportunity represented by the knowledge that they consider as free flowing during the introduction phase of a technology's life cycle. Perez and Soete (1988, p.476) explicitly argue that: "given the availability of well qualified university personnel, a window of opportunity opens for a relatively *autonomous* [own emphasis] entry into new products in new technology systems in its early phases". Thus, in countries with good universities, they perceived that the biggest problem for early entry by a developing country was not the lack of the types of actor (i.e. universities) able to start developing the scientific and technological part of the technology, but whether this endogenous generation of learning and product development could persist as the system evolved through continuous technological efforts and increasing flows of investment. In particular, they proposed two means of achieving this: through the formation of start-ups by the universities and through technology transfer from universities to the firms (Perez and Soete, 1988, p.476)

This argument by Perez and Soete, however, were rather speculative in nature and not supported by concrete and systematic empirical evidence. Yet since their 1988 article, research and publications on the role of universities in technological innovation have proliferated and Perez and Soete's propositions can be explored further in light of this new evidence. The subsequent section explores their proposition by reviewing three strands of literatures that may provide more insights on this issue: the literatures on entrepreneurial university/university-industry links, triple helix and system of innovation.

3.1. Entrepreneurial university/university-industry links

In the field of innovation studies, the most developed strand of the literature in terms of providing evidence on the role of universities in technological innovation describes the activity of universities being involved directly with firms-related activities.[3] This includes universities supporting firm's activities via various technology transfer channels or substituting for firms' activities through the formation of university spin-offs. The terms commonly used to describe these kinds of activities are university-industry links and entrepreneurial universities.[4] Indeed, there are positive developments in this kind of evidence - and therefore it can be said that in some sense, Perez and Soete's arguments in 1988 about the role of universities, via the formation of new firms and technology transfer in contributing to early entry can be justified.

However, there are some contradictory findings in the literature, particularly in the context of latecomers. For instance, it has been found that the formation of start-ups by university actors is largely a unique phenomenon based on empirical work on the biomedical industry. According to Mowery and Sampat (2005: p.221), findings by Mansfield (1991), Levin et al. (1987) and Cohen et al. (2002) showed that the biomedical industry, especially biotechnology and pharmaceuticals, is unusual in that advances in university research affect industrial innovation more significantly and directly in this field than in any other sector. In other technological and industrial fields, universities occasionally contributed relevant 'inventions', but most commercially significant inventions come from non-academic research. Furthermore, in terms of latecomer countries where the scientific and technological base is comparatively low, the exploitation of this free knowledge from the laboratory to the formation of firms is not easy and affordable (Bernasconi, 2005). As Tidd et al. (2002) highlight, university start-ups in new technologies are very rare and highly concentrated in a small number of elite universities in the advanced countries.[5] In fact, cases of successful university start-ups in latecomer countries are not very frequent in the literature.

In the case of technology transfer, evidence from latecomer countries is more promising. There are a number of articles showing universities in latecomer countries conducting successful technology transfer activities for industry (Hershberg et al., 2007; Wu, 2007; Choung et al., 2003). This evidence however, is small compared to the evidence on universities in the advanced countries.[6] Moreover, there are more articles that provide evidence of the limited capability of latecomer universities' in conducting technology transfer activities (Brimble and Doner, 2007; Guan et al., 2007; Adeoti and Adeoti, 2005; Pinheiro-Machado and Oliveira, 2004; Coutinho et al., 2003). Nevertheless, it should be noted that there are few authors in the latecomer country literature that would argue that the absence of successful start-ups by latecomer country universities does not mean it is not a viable strategy to pursue, but rather that it is a strategy that should be encouraged. They generally argue that this is particularly essential since latecomer

[3] The literature review is based on a search of articles in the Web of Knowledge. Relevant articles were identified using the keywords 'universities/university' and 'innovation'. The reason for using such general keywords was to ensure that the search would capture most of the articles discussing the role of universities in technological innovation. The abstracts of every articles were perused and the articles were categorised into four sets: University spin-offs or formation of firms, university-industry links, triple helix and innovation system. Each set was then divided to reflect its focus on advanced and latecomer countries.

[4] The differences between these two sets of literatures are not very clear. In both cases, the coverage of articles was the same, clearly seen when articles reviewing these two topics are compared: See de Campos (2007) and Agrawal (2001) for university-industry links and Rothaermel et al., (2007) for entrepreneurial universities.

[5] In fact, even in the cases of the Silicon Valley and Stanford University high tech regions, the role of university start-ups in their development was not very significant during their formative years. In the early years, universities' activities in industrial outreach in seeking satellite operations of established firms based elsewhere (such as Lockheed), were much more important (Adam, 2005).

[6] However, even in the advanced countries, some authors are of the opinion that universities are generally unsuccessful in producing commercial inventions and innovation (Henderson et al., 1998; Pavitt, 2001; Salter et al. 2000).

countries, by definition, lack the presence of innovative firms, and university start-up might be a way to overcome this intrinsic problem (Watkins-Mathys and Foster, 2006; Wong, 2007).

Indeed, the presence of innovative firms (or the demand side of the technology transfer process) is a very important issue, which is frequently downplayed in investigations of university-industry links in latecomer countries. As de' Campos (2007) highlights, various literatures in industrialised countries point to the significance of the demand side in inducing intensive university-industry links. For instance, he referred to the work by Mowery and Rosenberg (1989) on Japan, the US, Germany and Korea that it is only after firms have undertaken organised R&D activities that the demand for university-industry links increased. This can be explained by the firms' increased capacity to absorb external knowledge[7] from the universities. However, the existence of firms with strong R&D departments is still very low in most latecomer countries.

4.2. Triple Helix

As mentioned before, investigation into the role of universities in technological innovation has emphasised their direct relationships with firms. This is understandable in the context of the industrialised countries that most of these studies refer to; in this context there are many innovative firms, and universities in most cases complement firms' technological activities. Thus, existing research on the role of universities for economic development in industrialised countries tend to emphasise the role of universities in technological innovation as a two way university-industry link/entrepreneurial university issue (as described in the previous sub-section) rather than an issue involving the wider system. However treating the university's role as a system issue might be a more pressing need for latecomer countries where, as highlighted earlier, there is a lack of local innovative firms. As a result, in many latecomer countries local universities are usually seen as a beacon for anything related to new scientific discovery and advanced technological development. Therefore, a deeper understanding of how universities could be more innovative at the system level – than just their relevance to firms - might be an area deserving of greater attention in the latecomer context. Interestingly, even some advanced country authors are also beginning to broaden their approach to the systems level when discussing less developed regions (Benneworth and Hospers, 2007; Gunasekaran, 2006)

Furthermore, there has been recognition by experienced authors in the field that there is a need to observe the roles of universities within the context of innovation systems, the complex organisational and institutional landscapes that influence the creation, development and dissemination of innovation (Mowery and Sampat, 2005). This is because, although universities fulfil broadly similar functions in the innovation systems of most industrialised and industrialising economies, the importance of this role varies considerably, and is influenced by the domestic industry, the size and structure of other publicly funded R&D performers and numerous other actors. Hence, a move towards an innovation systems approach is recommended, especially in arenas where the university's role is rather vague and not adequately understood. The catching-up process of early entry, I contend, could be one of those arenas. Also, as discussed earlier in Section 2, the relationship between early entry and the development of innovation system is closely and invariably linked.

Such an innovation systems approach is partially adopted by the triple helix literature, which is a framework that focuses on the overlay of communication and expectations that reshape the institutional arrangements among universities, industries and government agencies. These three institutional spheres (public, private, academic), which formerly operated at arms' length, are seen to be working together increasingly, with a spiral pattern of linkages emerging at various stages of the innovation process, to form a 'triple helix' (Etzkowitz and Leydesdorff, 1988, 2000). In this literature, government and university actors are analysed at an equal level to firms. However, although the triple helix literature demonstrates that the university's role is very much interlinked with other parts of the innovation system, it is more concerned with looking at how the co-evolution of the three organisational spheres has affected universities in moving them away from their traditional role to playing a more prominent role in the entrepreneurial process. This becomes apparent if we look at some of the influential empirical work and findings within this literature,

[7] See Cohen and Levinthal (1990) on the concept of 'absorptive capacity'

which especially highlights the significance of incubators (Etzkowitz, 2002a; Etzkowitz et al, 2005), the entrepreneurial university (Etzkowitz, 2002b) and the increasingly pseudo-firm like character of university actors (Etzkowitz, 2003) in fostering wider economic development. As a result, the orientation of Triple Helix is closer to the university-industry links/entrepreneurial university literature with its focus on the transformation of universities in conducting firm-like activities.

4.3. System of Innovation

Another innovation system approach that recognises the role of universities in technological innovation is the system of innovation literature. However, there is less specific analysis of the role of universities in this literature, mainly because the system of innovation literature emphasises firms as learning organisations embedded within a broader organisational and institutional context, with other organisations, such as universities, typically considered to be the sources of firms' learning process. Thus, it was probably considered unnecessary to use the framework to analyse the specific role of universities. However, a call from one of its key authors, Richard Nelson (2004, p.371), may provide a signal that more in-depth analysis on the role of universities is needed in this literature, at least in terms of understanding the process of catching-up: "I want to argue that the research capabilities of universities and other public institutions will play an important role in catch-up in the 21st Century. Indeed, while often overlooked, indigenous research has long been an important element of catch-up in certain important fields".

However the potential of using the system of innovation as an approach to investigate the role of universities in early entry is highly promising. This can be particularly relevant since the system of innovation approach, from the times of its earlier focus on national innovation system (Freeman, 1987; Lundvall, 1992; Nelson, 1993) has flourished and became more sophisticated to include technology-specific system of innovation framework (Carlsson and Stankiewicz, 1991; Carlson et al., 2002). The assumption behind this technology-specific framework (or usually known as the 'technological system framework') is that there are many technological systems in a country or region, and some actors are involved in them. Each of the technological system is unique and they vary in their ability to develop and diffuse new technology.

This goes back to my specific research interest and earlier discussion on the conception of early entry. Early entry is about latecomer countries trying to catch-up economically through their early involvement in the development of new technologies. This emphasis on new technologies and the early phase of its development pinpoints, at least for now, towards the "technological system framework" as the most suitable tool to investigate the phenomena of early entry compared to other system of innovation frameworks. Why is this? This is due to its use of technology(ies) or knowledge field as its empirical boundary and its dominant experience in using emerging technologies as its empirical subject. Sectoral system of innovation on the hand are more suitable for analysing technologies at a later stage of its development i.e. when it can be readily grouped in particular sectors, while national innovation system is more suitable for broader purposes whereby delineation of specific technologies is not particularly important. Also, technological system is not necessarily confined to domestic and regional entities, but may be a part of larger international system – which is essential when analysing emerging technologies of the 21st century with its high level of internationalisation (See Table 1)

Table 1: Comparison of different system of innovation framework

	National Innovation System	**Regional Innovation System**	**Technological system**	**Sectoral System of Innovation**
Boundary	National	Regions	Specific technology(ies), product or knowledge field	Sector
International coverage of empirical work	No	Possible	Yes	Yes

Dynamic emphasis in empirical analysis	No	No	Yes	No
Type of technology typically used in empirical work	Various types	Various types	Emerging technologies	Technologies within defined sectors

Source: Author

In addition, the technological system framework has been employed much more frequently to investigate the emerging phase of a technology's development[8] and, as a result, this framework gives more emphasis to the dynamic nature in the development of innovation system compared to other system of innovation frameworks. This move within the technological system framework towards a dynamic analysis is understandable if we consider the volatile and unstable nature of emerging technologies. Also, as Hekkert et al. (2007) mention, the technology-specific focus of the technological system framework reduces the number of actors, networks, and relevant institutions that need to be analysed, making dynamic analysis more feasible. Hence, this framework enables us to go beyond the more established practice of concentrating on the static analysis of current structures of innovation systems.

Within the technological system framework, the recognition of universities as an important actor in system of innovation has been highlighted in a classic paper by Carlsson and Jacobsson way back in 1991 (p.237), which states that: "the educational system, in particular the university of technology, plays a critical role in the process of generating and diffusing knowledge". However, overtime, specific investigation on the role of universities generally became less pronounced within this literature, with the exception of Jacobsson's 2002 paper entitled 'Universities and industrial transformation'. Jacobsson's paper will be reviewed further in the next section and will act as the genesis for my proposition in applying the 'functional' innovation system approach for investigating the role of universities in early entry.

4. Investigating the role of universities in early entry: Towards a 'functional' system of innovation approach

In his 2002 paper, Staffan Jacobsson has suggested a novel way of using the technological system framework, specifically through the analysis of functions for understanding the role of universities in industrial transformation. This section attempts to explore Jacobsson's ideas further, and provide some discussion and opinions on how his ideas can be adopted to investigate universities' contribution in early entry.

However, before proceeding any further, it is essential to appreciate the key elements of the technological system framework, the theoretical and conceptual basis of Jacobsson's work. A technological system can be defined as: network(s) of agents interacting in the economic/industrial area under a particular institutional infrastructure for the purpose of generating, diffusing and utilising technology (Carlsson and Stankiewicz, 1991, p.94). Overtime, this framework has been operationalised in several ways and undergone several changes from its original version. Initially, the framework was characterised solely by its three-pronged structural components: actors and their competences, networks, and institutions. However, in recent years, the framework has also included the more dynamic concept of 'function' as another key element of its analysis.

[8] This includes the work on microwave technology, biomaterials, biotechnology and titanium implants (see the work by Holmén, Rickne, Laestadius and Fridh cited in Carlsson et al., 2002), wind turbines (Bergek and Jacobsson, 2004), solar cells (Jacobsson et al., 2004), biomass digestion/gasification (Negro et al., 2007a; Negro et al., 2007b; Negro and Hekkert, 2008a); biofuel (Suurs and Hekkert, 2009,) natural gas (Suurs et al., 2010) and renewable energy (Jacobsson and Johnson, 2000; Jacobsson and Bergek, 2004).

'Functions' constitute the intermediate level between the structural elements of a technological system and the performance of an innovation system. The idea is simply that the appropriate fulfilment of the functions by the structural components, through the interaction between its internal and external environment, would contribute to the final aim of the technological system - which is the successful generation, adoption and diffusion of new technologies. Thus, function tackles the 'process' part of the framework, i.e. what the structural components actually do and eventually achieve. This is considered practical in the case of emerging technologies, whereby typical measurement of economic performance are difficult to pin down due to the highly volatile and experimental nature of their performance (Bergek et al., 2005). According to Jacobsson (2002: p.348), there are two main reasons for analysing a technological system in functional terms:

> "First, there is no reason to expect a particular configuration of a technological system, or structure, to be related to the performance of the system in a clear and unambiguous way. By arranging our empirical material in terms of functions, we can trace the way in which a particular entry/exit pattern, actor combination or a specific institutional set-up shapes the generation, diffusion and utilisation of new technology. Second, we can define the border of the system, an inherently very difficult task,…by analysing what promotes or hinders the development of these functions.

In the other system of innovation frameworks, only the structural components were analysed in a systematic and comparable manner, while various functions in the system were analysed according to the analytical preference of individual researchers. Thus, although investigations on functions have always been a fundamental part of analyses of systems of innovation (see review in Chaminade and Edquist, 2005: p.11-20), there is no systematic and standardised way that findings can be compared in these investigations (Edquist, 2004). Current efforts by technological system analysts can be seen as moves forward in tackling this issue[9].

Nevertheless, the attempt by technological system analysts to specify functions can be considered too ambitious – how can the diverse perspectives on the different processes that need to occur in an innovation system be identified and systematised in a single list? An analyst from a different background might classify functions in a different way and it is difficult to decide what constitutes the most 'acceptable' list. In terms of policy however, some level of systematisation and standardisation can be very useful if busy policy makers and practitioners are to make better sense of the overall findings from the innovation systems approach (see a similar argument by Chaminade and Edquist, 2005). As long as the functional elements are considered too complex to systematise, policy makers will always emphasise the structural aspects of the framework in their policy making process. Nonetheless, the fact that the technological system analysts are constantly re-framing their list of functions shows that finding the most representative list remains a real difficulty, and poses an ongoing challenge for the field.

Going back to this paper's interest on the role of universities in early entry, Jacobsson (2002) provides examples of how universities as a set of actors can contribute to the development of functions - and this was used as a basis for his proposal in his paper that the role of universities in the process of industrial transformation (or development of new technologies) could be conceptualised as contributing to a range of innovation system functions. The examples are listed below:

- Create and diffuse knowledge.
  Examples of universities' contribution: Pursuit of groundbreaking research; Diffusion of knowledge from accumulated stock in the world
- Direction of search

[9] It should be noted that the suggestion of Chaminade and Edquist (2005) and Edquist (2005) on the use of ten activities to capture the operation of an innovation system is rather similar to the work on functions by technological system analysts, but their ideas are less developed in terms of verification with empirical work.

Examples of universities' contribution: Enlarging the technological opportunity set, by conducting doctoral research in new fields; Demonstrating the usefulness of a specific design approach.

- Direction of search
  Examples of universities' contribution: Enlarging the technological opportunity set, by conducting doctoral research in new fields; Demonstrating the usefulness of a specific design approach.
- Supply of resources
  Examples of universities' contribution: Supply of adequate numbers of undergraduates and postgraduates in particular knowledge fields; Supply of capital, especially seed capital and other resources essential for spin-off firms.
- Formation of markets
  Examples of universities' contribution:: Act as innovative customers, for instance in the procurement of instrumentation.
- Creation of positive externalities
  Examples of universities' contribution: Providing meeting places, participating in bridging organisations and joint R&D with industry.

In the paper Jacobsson (2002) only listed five key functions. However it is important to note that overtime, different list of functions have been developed by various authors and at present, the list is still evolving. In fact, in a 2008 Research Policy paper, Jacobsson and colleagues has reviewed, updated and consolidated recent work in this area (Bergek et al., 2008)[10]. In the paper, the lists of functions have been extended:

- Knowledge development and diffusion
- Influence on the direction of search
- Market formation
- Legitimation
- Resource mobilization
- Development of positive externalities
- Entrepreneurial experimentation

Unfortunately, although Jacobsson's idea on the use of this theoretical framework in investigating the role of universities in industrial transformation is promising, the paper did not expand about how the framework might be operationalised for systematic empirical research. This was perhaps intentional as the declared objective of the paper was to conduct "a selective and interpretive review of the literature on university-industry relations, to identify questions for further research" (Jacobsson, 2002: p.345).

In my view his ideas need to be explored further as it has the potential to address the problems faced by the current literatures, as highlighted earlier, in understanding the full spectrum of the roles fulfilled by universities. Especially so when one considers that current literatures tend to emphasise outputs which are easily quantifiable via the formation of firms and tangible technology transfer - and rarely address the broader matrix of university-industry relationships that span a broad range of activities and outputs. In fact, some authors are beginning to argue that other less investigated activities, such as conferences and consulting, as being more important channels for university input into industry R&D rather than conventional indicators such as patents, licensing, prototypes and start-ups (Mowery and Sampat, 2005). Along the same lines, Rosenberg (1992: 381) (based on his work on the role of university research and scientific instrument) suggested that there are paths of influence and causation within the universities' role in technological innovation which have not been systematically identified or examined, much less measured. In this case, Jacobsson's (2002) broader framework might be useful for exploring the role of universities in other important

[10] Important to acknowledge that similar efforts have also been conducted by the Dutch team from Utrecht University (Hekkert et al, 2007)

areas in the technological innovation process, which as suggested by Rosenberg, intentionally or unintentionally, have been overlooked.

In fact recent progress in the list of functions has placed Jacobsson's proposition very interestingly in the literature. For instance his idea of universities playing a role by contributing to the development of different system functions is particularly intriguing if we compare the updated list of system 'functions' in the technological system framework by Bergek et al. (2008) with the seven 'impacts of publicly funded research' provided in a SPRU review report (Salter et al., 2000: p.59-70). In comparing these typologies, some obvious overlaps and apparent gaps emerge (see Table 2). It is interesting that broader functions, such as influencing the direction of search, market formation, legitimation and development of positive externalities, are not seen as contributions of publicly funded research. Is this so? Such gaps in our understanding needs to be further explored.

Table 2: Comparing list of functions and the impacts of publicly funded research

Functions in a technological system Bergek et al. (2008)	**Impacts of publicly funded research Salter et al. (2000)**
Entrepreneurial experimentation	Creating new firms
Knowledge development and diffusion	Increasing the stock of useful knowledge
	Provision of social knowledge
	Forming networks and stimulating social interaction
Influence on the direction of search	-
Market formation	-
Resources mobilisation	Training of skilled graduates
	Creating new scientific methodologies and instrumentations
Legitimation	-
Development of positive externalities	-

Source: Author

Finally, according Jacobson and Berger (2006) in their paper entitled "A framework for guiding policy makers intervening in emerging innovation systems in catching-up countries", the development of innovation system 'functions', whether at local, national or regional level, can be used to systematically describe the process that latecomer countries need to undertake in order to increase their potential to achieve the aims of the technological system, which are to generate, diffuse and use new technology. This overriding aim of the technological system is similar to Perez and Soete's early entry objective, which is "to acquire the capacity for participating in the generation and improvement of technologies [sic], as opposed to the simple use of them" (Perez and Soete, 1988, p.459). Hence, one can then make some kind connection that the development of innovation system functions in an emerging technology by actors in a latecomer country will increase that country's potential to achieve early entry. This highlights another potential of using the technological system framework and its functional analysis to analyse the process of early entry.

In spite of its potentials - to date there has been no published empirical research that systematically uses this functional innovation system approach to address the role of universities in either advanced countries or latecomer countries. Even Jacobsson's (2002) work is limited in the sense that it does not include any ideas about how an empirical investigation could be operationalised. It therefore cannot be concluded absolutely positively that the approach is practical, and whether the evidence obtained will be useful for understanding the role of universities in early entry.

5. Operationalising the idea

Inspired by the ideas collected and synthesised from the literature, I have attempted to employ this 'functional' system of innovation approach (more specifically, using the technological system framework) - to conduct a multiple case study on the contribution of four universities in the development fuel cell technology (an emerging low-carbon energy technology) within two latecomer countries, Malaysia and Singapore. These are: Nanyang Technological University (NTU) and National University of Singapore (NUS) in the context of Singapore, and Universiti Kebangsaan Malaysia (UKM) and Universiti Teknologi Malaysia (UTM) in the context of Malaysia.

These cases were extremely apposite for this type of research due to the following reasons. First, universities in Malaysia and Singapore were amongst the earliest group of actors in their respective countries to be involved in the development of fuel cell technology. This began in the mid 1990s, since when various developments in the technology have occurred at the national level. Second, each of these latecomer countries had two universities that clearly were participating in the development of fuel cell technology. Being able to observe two clear cases within each latecomer context adds to the robustness of the research findings. Third, Malaysia and Singapore provide a comparative context to investigate two latecomer countries trying to enter into fuel cell technology development within a comparable time period (roughly a decade).

While the selection of fuel cells as the emerging technology context was mostly based on its image of being a ‘low carbon energy technology’ with pressing catching-up issues for developing countries (Mytelka, 2004; Mytelka and Boyle, 2006). Additionally, using fuel cell technology as the technology context has several advantages empirically. These include: (i) the relevance of fuel cell technology to the phenomenon under investigation i.e. universities worldwide are actively involved in the early development of the technology (OECD, 2006: 26); (ii) the ease of obtaining up to-date and well structured information due to current high levels of information sharing within fuel cell networks; and (iii) the availability of a number of articles that use the example of fuel cell technology to understand the innovation process in emerging technologies. This has been very useful in providing a good understanding of the particular characteristics and dynamics of this particular technology. The following sub-sections will cover other dimensions of the research: the analytical framework, sampling and data collection, analysis and finally, the key findings[11].

5.1. Analytical framework

The analytical framework of the research was based on the following logic: Starting from the premise that the development of innovation system functions in an emerging technology in a latecomer country increases that country’s potential to achieve early entry, I deduced that the role of universities in early entry could be investigated by analysing the universities’ contribution in developing these functions. The logic is that there is a system of actors that conduct various activities for the latecomer country, both on their own and in interaction with each other, through various networks and institutions. If these structural components contribute to the development of system functions during the introduction phase of a technology, this will increase the potential of early entry being achieved.

In order to connect how the set of structural components have contributed to the development of different functions, I used the concept of ‘activity’ which simply means something that actors do to achieve a particular aim. This connection is based on the root definition of the word ‘function’ as a “purposeful set of activities” (Oxford Advanced Learner’s Dictionary, 2000). For this research, functions could then be translated as a purposeful set of activities that originates from the interaction of a set of structural components in the innovation system. In principle, what is implied by the word activity is similar to Jacobsson’s (2002) idea in using the concept of ‘mechanism’ – which has the root meaning of a set of moving parts that performs a task. However, use of mechanism can be confusing. People can interpret this word differently; it has particular connotation for different groups of interviewees, and particularly policy makers, engineers and biologists. Also, mechanism implies a higher level of aggregation and consistency, and risks overlooking those activities that cannot be aggregated and are less consistent. I feel it is important to avoid this

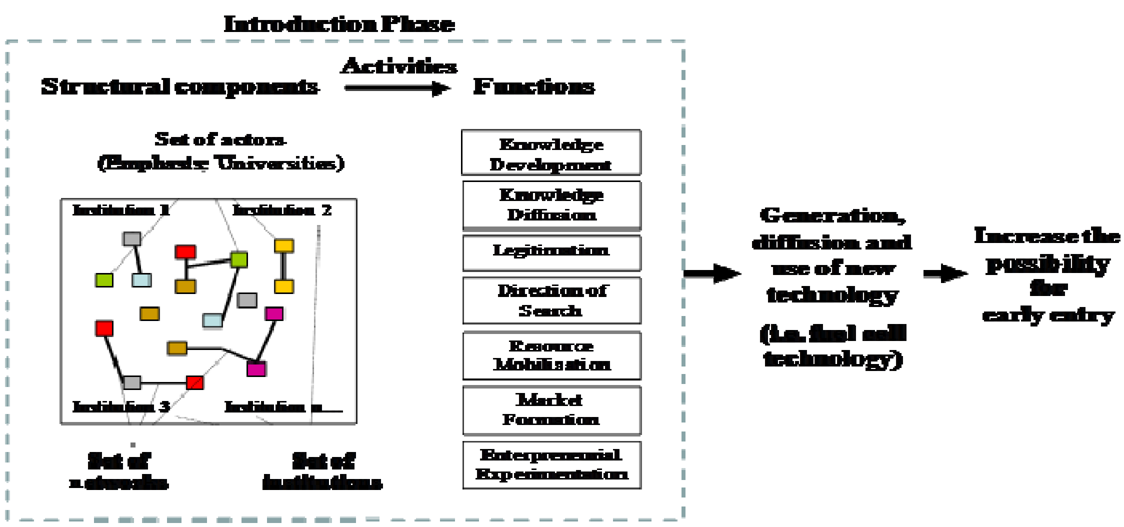
[11] A more elaborate reporting of this research can be obtained from my PhD thesis (Zeeda, 2009)

risk when conducting research on emerging technologies, where many new forms of activities are still being experimented with.

Hence, the extent of the universities' role in early entry can then be investigated by analysing how far the activities by universities (as a part of the structural component) contribute to the development of the functions. By adopting this system of innovation perspective, the focus of the analysis is on understanding how universities' activities, particularly through interactions with multiple actors, have contributed to the development of the functions. This is a broader approach to observe the universities' role in technological innovation and catching-up, than the more established methods of observing universities' entrepreneurial activities or their two-way relationships with firms. The analytical framework for this research is illustrated in Figure 2.

Figure 2:

Analytical framework for investigating universities' contribution for achieving early entry



Source: Own

5.2. Sampling, data collection and analysis

Because of the system of innovation approach adopted in this research, analysing the cases required a sampling of data that could describe how universities have interacted with other actors (within various networks and institutions) in contributing to the development of different types of innovation system functions for fuel cell technology in Malaysia and Singapore. This involved data on the universities, but also data on other actors in the fuel cell innovation system. To achieve this objective, the sampling procedure adopted was purposive and not wholly pre-specified, but evolved once the fieldwork began. It was based on the logic of 'theoretical sampling' (Miles and Huberman, 1994, p.28), a procedure in which cases are chosen for theoretical or analytical rather than statistical reasons. This was achieved by generally observing the different types of activities involved in fuel cell technology that are connected to the respective countries. This allowed the identification of a pool of actors, networks, institutions, time dimension, technological coverage and location to characterise the phenomena under investigation, thereby enabling the boundary to the research to be further defined.

A very important aspect of the data collection and analysis is the technique used to assess the extent of the universities' contributions to the development of the functions. Because of the exploratory nature of the research, the technique was not determined at the outset, but developed through a gradual process of understanding the pattern of the theoretical framework and empirical data. Based on this understanding, two levels for assessing the contribution of universities to the development of system functions were developed: (1) relevance of universities' activities; and (2) contribution of universities' activities to the development of system functions. 'Relevance' here means any activities that can potentially be used to develop the system function. 'Contribution' refers to the actual contribution of universities' activities to the development of each function at the system level. The reason for this distinction is simple. During the course of data collection it was apparent that although the universities' role in the development of fuel cell technology might be comparable in terms of relevance, they can be very different in terms of their contribution at the system level.

The assessment was conducted by analysing the significance of universities' activities to the development of system level function - especially in terms of the size and coverage of the relevant outputs in each area of the system function that are associated to these activities. 'Size' refers to how far universities and other actors have contributed to the number of outputs that are relevant to the development of each innovation system function, while 'coverage' refers to how far universities and other actors have contributed to different areas of outputs that are relevant to the development of each function.[12] The extent of universities' contribution function development is then determined according to the following scheme:

None:	university's activities had no relevance on the function.
Low:	university conducted activities relevant to the function, but with no clear contribution at system level.
Medium :	university conducted activities relevant to the function and with a clear contribution at system level, but relatively weak in terms of size or coverage, or both.
High:	university's activities contributed to the development of the function at system level, and relatively high in terms of size and coverage.
Very High	university's activities contributed to the development of the function at system level, relatively high in terms of size and coverage and the achievement is quite exceptional at the international level.

The primary data needed for this assessmenr were obtained by investigating the universities' activities relative to other actors, and the relevant outputs of these activities that can be used to indicate the contribution of these activities to the development of system functions in fuel cell technology. 'Output' is simply defined here as the tangible things that the activities has produced. The concepts of activity and output were used due to their general and flexible nature for analysing the phenomenon i.e. to provide a comparable, systematic and easily understandable concept for investigating the role of universities and analysing it in relations with other actors. Table 2 provides a description of the specific data that were collected under each function, together with their range of indicators. The data requirement is heavily guided by the work by Bergek et al. (2005; 2008) that was mentioned earlier in Section 3. The research combines both qualitative and quantitative data obtained from the five data sources that are usually employed in case

[12] 'Size' is a frequent criterion that has been used in various kinds of research, but the prevalence of 'coverage' is probably much more associated with the specific needs of this thesis. This can be seen in two ways: (1) High level of uncertainty of an emerging technology: therefore the innovation system needs adequate exposure and experimentation in different areas of the technology before identifying a suitable area to pursue; and (2) High level of system integration in fuel cell technology: therefore the development of the system functions requires adequate involvement in different levels of system integration to develop the technology effectively.

study research (Yin, 2003: p.86): mainly from interviews, documentation analysis, archival records and, to a limited extent, direct observation and physical artifacts. The data for this research began from the earliest period of the universities' activities until February 2007.

Table 3: Description of indicators for each system function and its sources

Function	Indicators
Knowledge development	Activities: Any activities where actors develop different areas of technical[2] knowledge in fuel cell technology. Outputs: Size, knowledge orientation and type of research activities through analysis of publications, patents, research projects; assessment by managers.
Knowledge Diffusion	Activities: Any activities where actors diffuse knowledge on fuel cell technology. Outputs: Number and knowledge orientation of journal citation, conferences, exhibitions, meetings, seminars, websites and other platforms where knowledge on fuel cells is diffused.
Enterpreneurial experimentation	Activities: Any activities where actors conduct support and promote entrepreneurial experimentation in fuel cell technology. Outputs: Number (i.e. number and variety of new entrants and diversification of established firms) and variety (i.e. firm's coverage in the different areas of the technology, plus the complementary technology employed) of entrepreneurial experiments in the system.
Direction of search	Activities: Any activities where actors guide the involvement of other actors in specific areas of fuel cell technology. Outputs: Number and type of actors in the system that has clear direction on what areas of the technology that needs to be developed (e.g. specific type of fuel cell, level of integration, market and competition/complementarity with other technologies). This could be in the form of visions, expectations and belief in growth potential; regulation and policy; articulation of demand from leading customers.
Legitimation	Activities: Any activities where actors influence social and political[2] acceptance and compliance with institutions that are needed to develop fuel cell technology. As a result, the technology is seen as appropriate and desirable by relevant actors. Outputs: Number and types of actors in the system that demonstrate the social and political acceptability of the technology, and the strength of their influence in shaping demand, policy, legislation and social behaviour towards the technology.
Market formation	Activities: Any activities where actors are involved, directly or indirectly, in creating different types of markets. Outputs: Size and type of current and potential markets, user groups, lead users, purchasing processes and formation of standards.
Financial Mobilisation	Activities: Any activities where actors are able to mobilise financial resources to support the different activities in the technology. Outputs: Size and type of financial capital that can be obtained by various organisations in the system e.g. in the form of funds, investments and venture capital.
Human Resource Mobilisation	Activities: Any activities where actors are able to mobilise human resource to conduct different activities in the technology. Outputs: Size and type of human capital that has been used to support different activities in the system.

Source: Own

In order to arrange the analysis systematically, two types of analysis were conducted: within-case analysis and cross-case analysis. The within case analysis investigates the universities' roles case by case (i.e. the roles of UKM, UTM, NUS and NTU), while the cross-case analysis compares the findings from each case analysis. The within-case analysis aims at describing, understanding and explaining the findings within a single, bounded context, while the cross case analysis is conducted to increase 'generalisability', i.e. to enable consideration of the processes and outcomes across many cases, to understand how they are qualified by local conditions and, thereby, develop more sophisticated descriptions and more powerful explanations of the social phenomenon being investigated (Miles and Huberman, 1994, p. 172).

5.3. Key Findings

At the most basic level, the research has found that the local universities in Malaysia and Singapore have conducted activities that are relevant to the development of system functions in fuel cell technology. However, the translation of these activities in providing a significant contribution at the system level has not been automatic or equal across the different functions. It is apparent that the universities have provided stronger contribution in areas associated with the 'conventional' roles of universities i.e. knowledge development, knowledge diffusion and to some extent, human resource development. It is also interesting to observe that three out of the four universities have provided some level of contribution to 'legitimation' and 'direction of search' activities, two types of system functions that the literature (as highlighted earlier in Section 4) do not usually associate with universities. Conversely, the universities' contribution to entrepreneurial experimentation, a function that is currently receiving much attention in the literature, is not very significant. The research confirms that the universities do not make much of a contribution to market formation and financial mobilisation.

It is also clear that the universities in Singapore, collectively, make a relatively bigger contribution to the development of system functions compared to those in Malaysia. However, the significance of the universities' contributions is not simply correlated with country differences. The contribution of NTU in Singapore has been much greater in both scale and coverage than that of the other three universities, while the contribution of NUS in in Singapore has the smallest coverage of the four. This points to the importance of recognising the specific features of university research activities that might influence this contribution. Two key features are the technology coverage of university research activities and the significant roles of influential individuals with broad expertise in the technology. Without the universities' research involvement in particular areas of technology and without the presence of such individuals in their research groups, it is less likely that the universities can provide effective contributions.

Another important finding is that the extent of the universities' contribution is also related to the the important role of non-university actors in functional development, and the significance of their activities in enabling the universities' contributions. It is clear that when functional development is significant and reasonably comprehensive, as in Singapore – this is a systemic process involving the active participation of university and non-university actors. Correspondingly, where non-university actors do not contribute significantly to system functions development, as in Malaysia, the overall development of system functions remains weak and unbalanced. Even the seemingly proactive attempts by Malaysian universities to conduct relevant activities in the technology have not translated into an effective contribution at system level due to insufficient support from other actors. This is an indication that the initiation of a fuel cell innovation system, even in the introduction phase, cannot depend on the universities' activities alone, but requires strategic support and systemic interaction with various types of actors.

The research has shown that the significant contribution of non-university actors is particularly obvious in terms of the role played by three types of actors: government agencies, large firms and local PRIs. In Singapore, it is clear that the most influential of these actors were the government agencies, such as the Economic Development Board (government agency responsible for planning and executing strategies to sustain Singapore's position as a global hub for business and investment) and A*STAR (the government agency responsible to foster scientific research and talent in Singapore) and the multinational firm, Rolls Royce. This is in line with international trends where public-private partnerships between large multinational firms and government agencies seem to play a dominant role in driving the development of fuel cell developments worldwide – both currently and throughout their evolution since the 1950s (OECD, 2005). In Malaysia, the role of these prime movers is not evident.

Finally, the research findings also show that the contribution to functional development, whether by university or non-university actors, has been significantly shaped by several features of the instututional, or more specifically, policy environment in Singapore and Malaysia. Three features appear to be important: the synergy between environmental, energy and industrial policy; openness to internationalisation policies; and responsiveness to demand-side policies. In Singapore the stronger presence of these three features in the policy environment has had a positive influence on the contributions made by the universities and other actors to functional development. In contrast, the absence or weaknesses of these features might have contributed to the weaker and more unbalanced development of system functions in Malaysia. See Zeeda (forthcoming) for more elaboration on these institutional aspects of the findings.

6. Conclusion and the way forward

This paper has demonstrated that the system of innovation approach, particularly through the application of its functional analysis, has the potential to provide useful insights that are less detectable using more established approaches, at least for the purposes of understanding the role of universities in contributing to the catching-up strategy of early entry. This is because the extent to which the universities are able to provide a contribution to the development of an emerging technology is related not only to their own activities and to their two way interaction with firms, but is also closely linked to their association with broader set of actors and broader set of functions. Furthermore, the empirical evidence has shown that universities' contribution is very much dependent on the abilities and conscious decisions of other actors, particularly the prime movers, to make use or not of what universities were offering. In other words, although universities in latecomer countries may conduct various activities in the development of an emerging technology – their actual contribution to its development is highly determined by the competencies, needs and perceptions of other actors in the system, at both local and international levels. Therefore, any efforts to promote the role of universities' in achieving early entry need to be complemented with a proper understanding and appreciation of the system environment.

This implies that policymakers in latecomer countries need to make more critical adoption of strategies popular in the industrialized countries in using universities to enhance their catching-up process. This includes, for instance, policies on university research funding, establishing technology transfer offices, creating university spin-offs, encouraging university patenting etc. This is because if one consider the system of innovation perspective – the ability of universities to provide their contribution is not only related to the universities' organisational capacities or their direct linkages with firms, but also to their ability to position themselves strategically in various parts of the innovation system.

In the industrialised world, this systemic aspect of universities' role in technological innovation may not be so crucial to analyse for the obvious reason that the innovation systems in these countries are well developed (especially in the context of new technologies) and therefore are more able to complement universities' activities with little policy intervention. But the innovation system in latecomer countries is not as well developed, and it may be riskier to adopt such a 'hands-off' approach to dealing with the impact of the system environment on shaping universities' contributions. The empirical evidence on the development of fuel cells in Malaysia and Singapore for instance, has shown that a proactive, system level policy considerably enhanced the contribution of the universities in Singapore, compared to the lack of systems consideration in Malaysia. In other words, it points to the imperative for policy makers in latecomer countries to consider the specific circumstances of their innovations systems, whether this be strengths or weaknesses, in complementing universities' activities. On this basis, we could make a more informed decision about how far it is feasible to support the universities' role in early entry. Such considerations would enable policymaking to be more realistic and dynamic compared to the easier but less responsive practice of borrowing packaged policy ideas derived from the situations in advanced countries - which necessarily downplay the unique system level circumstances of latecomer countries. However, as a final note, it is important to reinstate that my proposition in this paper is still limited due to the exploratory nature of its empirical work. Therefore more work needs to be done to further assess the feasibility of this proposition.

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REFERENCES

Adam, S. B. (2005). Stanford and Silicon Valley: Lessons on becoming a high-tech region. California Management Review, 48(1), 29-51.

Adeoti, J., & Adeoti, A. (2003). Biotechnology R&D partnership for industrial innovation in Nigeria. Technovation, 25(4), 349-365.

Agrawal, A. (2001). University to industry knowledge transfer: Literature review and unanswered questions. International Journal of Management Review, 3(4), 285-302.

Akamatsu, K. (1962). Historical pattern of economic growth in developing. The Developing Economies, 1, 3-25.

Bell, M., & Pavitt, K. (1993). Technological accumulation and industrial growth: Contrasts between developing and developed countries. Industrial and Corporate Change, 2(2), 157 - 210.

Benneworth, P., & Hospers, G. (2007). Urban competitiveness in the knowledge economy: Universities as new planning animateurs. Progress in planning, 67, 105-197.

Bergek, A., & Jacobsson, S. (2004). The Emergence of a growth industry: A comparative analysis of the German, Dutch and Swedish Wind Turbine Industries. In S. Metcalfe & U. Cantner. (Eds.), Change, Transformation and Development. Heidelberg: Physica-Verlag.

Bergek, A., S. , Jacobsson, B., Carlsson, S., Lindmarkii, S., & Rickne, A. (2005). Analyzing the dynamics and functionality of sectoral innovation system - a manual. Paper presented at the DRUID Tenth Anniversary Summer Conference 2005, Copenhagen, Denmark

Bergek, A., S. , Jacobsson, B., Carlsson, S., Lindmarkii, S., & Rickne, A. (2008). Analyzing the functional dynamics of technological innovation systems: A scheme of analysis. Research Policy, 37, 407–429.

Bernasconi, A. (2005). University entrepreneurship in a developing country: The case of the P. Universidad Catolica de Chile, 1985-2000. Higher Education, 50(2), 247-274.

Brimble, P., & Doner, R. (2007). University-industry linkages and economic development: The case of Thailand. World Development, 35(6), 1021-1036.

Carlsson, B., Jacobsson, S., Holmén, M., & Rickne, A. (2002). Innovation systems: analytical and methodological issues. Research Policy, 31, 233-245.

Carlsson, B., & Stankiewicz, R. (1991). On the nature, function and composition of technological systems Journal of Evolutionary Economics, 1, 193-118.

Cohen, M., & Levinthal, D. (1990). Absorptive capacity: a new perspective on learning and innovation Administrative Science Quarterly 35, 128-152.

Coutinho, M., Balbachevsky, E., Holzhacker, D., Patrao, D., Vencio, R., Da Silva, R., Lucatelli, M., dos Reis, L., & Marin, M. (2003). Intellectual property and public research in biotechnology: the scientists opinion. Scientometrics, 58(3), 641-656.

Chaminade, C., & Edquist, C. (2005). From theory to practice: the use of systems of innovation approach in innovation policy. CIRCLE Electronic Working Paper Series (Paper no. 2005/02). Lund University

Choung, J., Min, H., & Park, M. (2003). Patterns of knowledge production: The case of information and telecommunication sector in Korea. Scientometrics, 58(1), 115-128.

de Campos, A.L. S. (2006) University-industry links in late-industrialising countries: A study of Unilever Brazil. PhD Thesis, Brighton: University of Sussex, pp. 306

Edquist, C. (2004). Reflections on the systems of innovation approach. Science and Public Policy, 31(6), 485 – 489.

Edquist, C. (2005). System of Innovation: Perspective and challenges. In J. Fagerberg & D. C. Mowery & K. Nelson (Eds.), The Oxford Handbook of Innovation (pp. 181 - 208). Oxford, New York: Oxford University Press.

Etzkowitz, H. (2002a). Incubation of incubators: innovation as a triple helix of university–industry–government networks. Research Policy, 29(2), 115-128.

Etzkowitz, H. (2002b). MIT and the rise of enterpreneurial science, New York: Routledge

Etzkowitz, H. (2003). Research groups as 'quasi-firms': the invention of the entrepreneurial university. Research Policy, 32: 109–121.

Etzkowitz, H., de Mello, J. M. C., & Almeida, M. (2005). Towards "meta-innovation" in Brazil: The Evolution of the Incubator and the Emergence of Triple Helix. Research Policy, 34, 411-424.

Etzkowitz, H. & L. Leydesdorff (1988). The endless transition: A "triple helix" of university-industry-government relations. Minerva, 36, 203-208.

Etzkowitz, H. & Leydesdorff, L. (2000). The dynamics of innovation: from National Systems and ''Mode 2'' to a Triple Helix of university–industry–government relations. Research Policy. 29, 109–123.

Freeman, C. (1987) Technology policy and economic performance: Lessons from Japan. London: Pinter

Freeman, C. (2002). Continental, national and sub-national inovation systems - complementarity and economic growth. Research Policy, 31, 191 - 211.

Guan, J. C., Yam, R. C. M., & Mok, C. (2007). Collaboration between industry and research institutes/universities on industrial innovation in Beijing, China Technology Analysis & Strategic Management, 17(3) 339-353.

Gunasekara, C. (2006). Universities and associative regional governance: Australian evidence in non-core metropolitan regions. Regional studies, 40(7), 727-741.

Hekkert, M. P., Suurs, R. A. A., Lente, H. V. & Kuhlmann, S. (2007). Functions of innovation systems: A new approach for analysing technological change. Technological Forecasting & Social Change, 74, 413-432.

Henderson, R., Jaffe, A. B. and Trajtenberg, M. (1998). Universities as a source of commercial technology: A detailed analysis of university patenting. The review of Economics and Statistics, 80(1), 119-127.

Hershberg, E., Nabeshima, K., & Yusuf, S. (2007). Opening the ivory tower to business: university-industry linkages and the development of knowledge-intensive clusters in Asian cities. World Development, 35(6), 931-940.

Hobday, M. (1995). Innovation in Asia: The challenge to Japan. Edward Elgar: Cheltenham.

Jacobsson, S. (2002). Universities and industrial transformation: an interpretative and selective literature study with special emphasis on Sweden. Science and Public Policy, 29(5), 345-365.

Jacobsson, S., & Bergek, A. (2004). Transforming the energy sector: the evolution of technological systems in renewable energy technolog. Industrial and Corporate Change, 13, 815 – 849.

Jacobsson, S., & Bergek, A. (2006). A Framework for guiding policy makers intervening in emerging innovation systems in "catching-up" countries. The European Journal of Development Research, 18(4), 687-707.

Jacobsson, S., & Johnson, A. (2000). The diffusion of renewable energy technology: An analytical framework and key issues for research. Energy Policy, 28, 625-640

Jacobsson, S., Sandén, B. A., & Bångens, L. (2004). Transforming the energy system--the evolution of the German technological system for solar cells. Technology Analysis & Strategic Management, 16(1), 3-30.

Johnson, A. (2001) Functions in Innovation System Approaches. DRUID's Nelson-Winter Conference, Aalborg, Denmark. June 2001

Joppe, M. (2007). The Research Process. [Online] USA, Ryeson University.
Available from: http://www.ryerson.ca/~mjoppe/rp.htm [Accessed on 13 June 2007]

Juma, C. & Clark, N. (2002). Technological catch-up: opportunities and challenges for developing countries: research report. United Nations Development Programme (UNDP).

Juma, C. and Lee, Y-C. (2001). UN Millennium Project Report: Task Force on Science, Technology and Innovation. UN Millenium Report United Nations

Kim, L. S. (1997). Imitation to innovation: The dynamic of Korea's technological learning. Boston: Harvard Business School Press.

Lundvall, B. (Ed.). (1992). National system of innovation: Towards a theory of interactive learning. London: Pinter.

Miles, M. B. and Huberman, A. M. (1994). An expanded sourcebook: Qualitative data analysis, 2nd Ed. London: Sage Publications
Mowery, D. C. and Sampat, B. N. (2005). Universities in national innovation systems. In J. Fagerberg & D. C. Mowery & K. Nelson (Eds.), The Oxford handbook of innovation (pp. 209 – 239) Oxford, New York: Oxford University Press.
Mytelka, L. (1993). Rethinking development: A role for innovation networking in the 'other two-thirds. Futures, July/August, 694-712.
Mytelka, L. K. (2000). Local system of innovation in a globalized world economy. Industry and Innovation, 7(1), 15-32.
Mytelka, L. (2003). New wave technologies: Their emergence, diffusion and impact. The case of hydrogen fuel cell technology and the developing world. UNU/INTECH Discussion (Paper DP 2003-3)
Mytelka, L. (2004). Catching up in new wave technologies. Oxford Development Studies, 32, 389 – 405.
Mytelka, L., & Boyle, G. (2006). Hydrogen fuel cells and transport alternatives: Issues for developing countries. Policy Brief 3, United Nations University.
Negro, S. O., Hekkert, M. P. and Smits, R. E. (2007a). Explaining the failure of the Dutch innovation system for biomass digestion—A functional analysis. Energy Policy. 35(2), 925-938.
Negro, S. O., Suurs, R. A. A., & Hekkert, M. P. (2007b). The bumpy road of biomass gasification in the Netherlands: Explaining the rise and fall of an emerging innovation system. Technological Forecasting & Social Change. 75, 57 – 77.
Negro, S., & Hekkert, M. P. (2008a). Explaining the success of emerging technologies by innovation system functioning: the case of biomass digestion in Germany. Technology Analysis & Strategic Management, 20(4), 465-482.
Negro, S. and Hekkert, M. P. (2008b). Dynamics of Technological Innovation Systems: Empirical Evidence for Functional Patterns. Paper presented at the 5th International Conference on Innovation & Management (ICIM). Maastricht, the Netherlands. December 10-11, 2008
Nelson, R. (Ed). (1993). National Innovation Systems: A comparative analysis. New York: Oxford
Nelson, R. (2004). The challenge of building an effective innovation system for catch-up Oxford Development Studies, 32(3), 365 - 374.
Organisation for Economic Co-operation and Development (OECD) (2006). Innovation in Energy Technology: Comparing National Innovation Systems at the Sectoral Level: A research report. Paris, OECD.
Pavitt, K. (2001). Public policies to support basic research: what can the rest of the world from US theory and practice? (And what they should not learn). Industrial and Corporate Change, 10(3), 761-779.
Peréz, C. (2001). Technological change and opportunities for development as a moving target. Cepal Review, 75(December 2001), 109-130.
Pérez, C., & Soete, L. (1988). Catching-up in technology: entry barriers and windows of opportunity. In G. Dosi & C. Freeman & R. R. Nelson & G. Silverberg & L. Soete (Eds.), Technical change and economic theory. London: Pinter publishers.
Pinheiro-Machado, R., & Oliveira, P. (2004). A comparative study of patenting activity in US and Brazilian scientific institutions. Scientometrics, 61(3), 323-338.
Rosenberg, N. (1992). Scientific instrument and University Research. Research policy, 21(4), 381 - 390.
Rothaermel, F. T., Agung, S. D. and Jiang, L. (2007). University entrepreneurship: a taxonomy of the literature. Industrial and Corporate Change 12(7): 921-941.
Salter, A., D' Este, P., Pavitt, K., Scott, A., Martin, B., Geuna, A., Nightingale, P., & Patel, P. (2000). Talent, not technology: the impact of publicly funded research on innovation in the UK: A SPRU Report commissioned by the Committee of Vice-Chancellors and Principals (CVCP) and the Higher Education Funding Council for England (HEFCE) Science and Technology Policy Research (SPRU), University of Sussex.
Suurs, R. and Hekkert, M., Kieboom, S. and Smits, R. E. H. M. (2009) Understanding the formative stage of technological innovation system development: The case of natural gas as an automotive fuel. Energy Policy. 38, 419 – 431

Suurs, R. and Hekkert, M (2010) Competition between first and second generation technologies: Lessons from the formation of a biofuels innovation system in the Netherlands. Energy. 34, 669 - 679

Tidd, J., Bessant, J., & Pavitt, K. (2002). Managing innovation: Integrating technological market and organisational Change (2nd ed.). Chichester: Wiley.

Vernon, R. (1966). International investment and international trade in product life cycle The Quarterly Journal of Economics, 80, 190-207.

Watkins-Mathys, L., & Foster, M. J. (2006). Entrepreneurship: the missing ingredient in China's STIPs? Entrepreneurship and regional development, 18(3), 249-274.

Wong, P.-K. (2007). Towards an entrepreneurial university model to support knowledge-based economic development: The case of the National University of Singapore. World Development, 17 (7-8), 523-527.

Wu, W. (2007). Cultivating research universities and industrial linkages in China: The case of Shanghai World Development, 35(6), 1075-1093.

Yin, R. (2003b). Case study research: Design and methods (Third Edition). London Sage Publications

Zeeda, F. M. (2009) The role of universities in national catching-up strategies: Fuel cell technology in Malaysia and Singapore. PhD Thesis, Brighton: University of Sussex, pp. 337

Zeeda, F. M (forthcoming) ‘The emergence of fuel cell technology and challenges for catching-up: Insights from Malaysia and Singapore, Int. J. Technology and Globalisation

UNIVERSITY AND SMALL MEDIUM ENTERPRISE LINKAGE: A CASE STUDY OF CENTER FOR INNOVATION, ENTREPRENEURSHIP AND LEADERSHIP (CIEL) IN INSTITUT TEKNOLOGI BANDUNG

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Abstract
The mutual benefits from collaboration between university and small medium enterprise (SME) have long been recognized in developed county. This collaboration concept is an important social aspect in the developing country's innovation system. This study evaluates the existing collaboration between The Center of Innovation, Entrepreneurship and Leadership (CIEL), from School of Business and Management ITB in Bandung, and some SME in its region. This research describes the identification of potential for university – SME linkage, the difficulty and discusses various ways to enhance the linkage in the future. Most of the collaboration between university and SME were found to be in consultancy activities such as training workshops and short courses. This paper contributes to enhance knowledge of collaboration between university and small medium enterprise in Indonesia.

Keywords: Center of Innovation, Entrepreneurship and Leadership (CIEL), Institut Teknologi Bandung (ITB), Small Medium Enterprise (SME), University

I. INTRODUCTION

In the past decade two important side facing Indonesia's economy are the problem of economic growth and employment. Meanwhile, the economic power of Indonesia in the future will rest on three pillars, namely democracy, economy and empowerment of local Small and Medium Enterprises (SMEs). SMEs are developed because the egalitarian and rational reasons have a strategic role, both social and economic nature. Socially, politically, SMEs contribute to employment and poverty reduction efforts, while the economic functions that SMEs provide goods and services to consumers buying low-power to a high purchasing-power, which finally made a major contribution in the acquisition of foreign exchange [4][5][8]. Small industries to strengthen the position of national employers who have engaged in this field and is the capital for the construction of the base itself on sourcing local agricultural materials and other materials, which may be sold in markets at home and abroad.

Until early 2007 there were nearly 300,000 SMEs-based industries in Indonesia that made contribution to Indonesia GDP about 60%, which 42% is contributed by Small enterprise and Micro businesses, and 18% is contributed by other medium-sized businesses (such as the Cooperative). SMEs are increasing rapidly as the complex problems. The main problem of SMEs can be the capital, less able to expand its business, difficulties in information and marketing (domestic and export), limitations in production techniques and management skills and limited manpower [4]. Meanwhile, SMEs face the challenges as opportunities increasingly open market, the introduction of new production technology, efficiency and productivity, the emergence of new business players as well as increased competition.

SMEs in Indonesia is having difficulties in capturing these opportunities that require products with better quality and prices and good service, after sales service, larger production quantities, and homogeneous product standards [10].Universities may have a significant impact upon their local economy [12]. The role of the universities in developing national industry, specifically small and medium enterprises (SMEs) is essential as the strategy to revitalize Indonesian universities to transfer know-how from laboratory to industry [10]. Thus the development and empowerment of SMEs not only get the serious attention of the government but also from other sectors, such as the private sector and universities [4][6][7].

The higher education must be among the most important intellectual and creative resources assembled to address an array of critical challenges confronting society—including the sustainability of natural resources; the provision of health care for all in a growing, aging population; and the renewal of economic vitality across a wide demographic range, which entails helping more working adults acquire higher-level skills and knowledge, instilling core human values, and strengthening social structures to ensure that future generations experience lives of justice, equity, and fulfillment. Higher education must organize its resources for increased responsiveness to, and engagement with, society's core challenges in the century ahead.[13]

In the Indonesia Higher Education Law No. 15 year 1961, there is Tri Dharma Perguruan Tinggi stated three pillars of Indonesia national higher education; learning, research, and community service. Higher education has two fundamental responsibilities to help ensure the continued well-being of the nation today: the first is providing graduates and the nation at large with the skills needed to be effective in a global, increasingly competitive economy, in which corporations reach across nations and geographical divides in search of new markets, more efficient production, and less costly labor and the second is closing the gap between those students who live in welfare area and not welfare by educationally, culturally, and economically.

The existence of Higher Education has a position and a very important function in the development of a society [6][7]. The process of social change in the community so quickly demanded that the position and function of the higher education that really happen in a real role. With Tri Dharma Higher Education, it is expected to perform the role of community and cultural transmission "to educate", the higher education is expected to perform dharma study the new findings of science and innovation, and the dharma community service in the service of society, higher education is expected to accelerate the process of improving the welfare and progress of society. Through this community service higher education's dharma will also get feedback from the public about the progress and relevance of science was developed by higher education.

Utilization in the relationship (or other terms link and match) between higher education and SMEs where there is a complementary interwoven, will enhance the role of higher education as a source of learning, and SMEs as partners of development and innovation of science and technology [6][7]. Today higher education required to be more involved in the application of good science for SMEs, whether the SMEs that are still modest and that has been independent. That role is characterized by stretching increases the range of higher education to be a research university and SMEs as a source of large tracts of land to the application of science and technology results from the natural processing. By understanding the role of each course will be a synergy of mutual support between the higher education and SME.

ITB, with its special expertise in technology, have been trying to create applied technology in terms of devices for local SMEs together with industry. ITB has been helping SMEs toward technical assistance funded by certain industry to produce spare part for this industry [10]. This research discuss a study case of the linkage between the role of ITB as a higher education to enhace SMEs in Bandung City through one of its centre (CIEL). Drawing from the problem above, this paper reviews relevant writings to address "how is the linkage between CIEL and SMEs' in Bandung?" and "what are the key factors that influence success of higher education-SMEs' linkage?". The paper is organized into several sections. The first section provides the introduction while the next section discusses about SMEs. Third section discuss about CIEL. The forth discussed of the existing condition of CIEL-SMEs linkage in Bandung City. The fifth section concludes the paper, and the last is the future work.

II. Literature review

Small Medium Enterprise

The definition of SMEs varies from country to country in terms of number of employees, value of total assets and total sales. In the European Union, SMEs are defined in the Commission Recommendation of May 6, 2003. Concerning to this recommendation an enterprise is regarded as small or medium sized if it has ¾ not more than 250 employees and ¾ not more than 50 Million Euro turnover resp. a balance sheet total of less than 43 Million Euro ¾ and if not more than 25% of the shares of such an enterprise are in the ownership of another enterprise [1][2].

The British Bankers Association (2008) stated that small business customers are defined as sole traders, partnerships, limited liability partnerships and limited companies with an annual turnover of under £1 million, as well as associations, charities and clubs with an annual income of under £1 million. If the concern applying for the business account is a group of businesses, the turnover threshold applies to the combined turnover of a group of limited companies and not individual companies within the group [1][2].

[13] http://www.highereducation.org/reports/wegner/wegner.pdf

In the USA, the definition of small business is set by a government department called the Small Business Administration (SBA) Size Standards Office. The SBA uses the term “size standards” to indicate the largest a concern can be in order to still be considered a small business, and therefore able to benefit from small business targeted funding. The concern cannot be dominant in its field, on a national basis. It must also be independently owned and operated. Unlike the UK and the European Union which have simple definitions applied to all industries, the US has chosen to set size standards for each individual NAICS coded industry [1][2]. This variation is intended to better reflect industry differences. The most common size standards are:

- 500 employees for most manufacturing and mining industries
- 100 employees for wholesale trade industries
- $7 million of annual receipts for most retail and service industries
- $33.5 million of annual receipts for most general & heavy construction industries
- $14 million of receipts for all special trade contractors
- $0.75 million of receipts for most agricultural industries

In accordance with Indonesia National Law Number 20 Year 2008 on Micro, Small and Medium Enterprises (SMEs), micro business is defined as a productive enterprise owned by individuals and / or private entities that meet the criteria as set forth in this Act [3]. Small business is productive economic activities of an independent, conducted by an individual or business entity that is not a subsidiary or branch of a company not owned, controlled, or a part, either directly or indirectly from medium or large businesses that meet the criteria Small businesses as defined in this Act. Medium enterprises are economically productive stand-alone, conducted by an individual or business entity that is not a subsidiary or branch companies owned, controlled, or a part, either directly or indirectly with small or large enterprise with the amount of net worth annual sales or as stipulated in this Act. The criteria of this enterptise can be seen in table 1.

Table 1 SMEs’ Criteria

No.	Description	Criteria	
		Asset	Turnover
1.	Micro Business	Max. 50 Million	Max. 300 Million
2.	Small Business	> 50 Million - 500 Million	> 300 Million - 2.5 Billion
3.	Medium Enterprises	> 500 Million - 10 Billion	> 2.5 Billion - 50 Billion

Source: The Ministry of Cooperatives and Small and Medium-sized Republic of Indonesia, 2008

Small Medium Enterprise in West Java

Number of SMEs in West Java in 2008 reached 8,214,262 units, 13,911,531 people are able to absorb labor force contribute to the Economic Growth Rate (Laju Pertumbuhan Ekonomi) of 8.04 percent of West Java and West Java GDP of Rp 345.187 billion. Whereas, the cooperative is based on data as of August 2010 totaled 22 664 units, with the number 14 771 7893 cooperatives active and inactive cooperatives. The number of 4,576,978 people, with business volume reached USD 10.312 trillion, Rp 8.831 trillion, and business assets (Sisa Hasil Usaha) reached Rp 1.017 trillion [9].

There are several West Java provincial government policy in encouraging the growth of SMEs through the development of which SMEs’ centers. Empowerment and development center's existence is necessary in establishing a strong and sustainable foundation. LAPI ITB team analyzes the results of the centers of SMEs in West Java, the condition of SMEs in the west region are concentrated in Bandung District (44%), followed by Bandung City (30%), Sumedang District (17%) and Cimahi (19%). Conditions of SMEs in the east region are concentrated in Garut (28%), Tasikmalaya District (26%), Kudat District (23%), Tasikmalaya City (17%) and Banjar (6%) [9].

III. METHODOLOGY

The case study in this paper aims to explore and reflect the experience of CIEL as university intermediaries to the SME. This case study involved discovering the obstacles and barrier in intermediaries with the SME. The case study approach is based on review scientific papers, analysis of available statistical data, interview and other secondary data. This paper has three sections; the first part describes literature review of SME, second part describes about university and SME linkage in ITB, the third part describes about the actual finding and discovers the obstacles of the linkage.

IV. UNIVERSITY AND SME LINKAGE IN ITB

CIEL is one of studies centre in School of Business and Management ITB. In practice, these studies centre adhere to the three pillars that form the basis in the areas of expertise include:
1. SME development
2. Entrepreneurship development; and
3. Development and dissemination of scientific fields

The vision of CIEL is a study center that has a reputation in Asia; which serves as a media in a multidisciplinary scientific development in the area of innovation, entrepreneurship, and leadership, and as a center of information and development of SMEs in Indonesia.
To achieve the vision, CIEL also have missions which are:

1. Develop and enhance the human resource (HR), particularly those engaged in the level of SMEs;
2. Disseminate the spirit and entrepreneurial activity;
3. Disseminate and develop research in the area of innovation, entrepreneurship, and leadership.

The objectives from CIEL are:

1. Increase research that is applied in the area of innovation, entrepreneurship, and leadership, which involves multi-disciplinary and cross-group skills (KK);
2. Publicize the research, so that benefits can be felt by the community;
3. Establish / increase the number of partnerships with third parties;
4. Doing business in the form of community service activities and assistance to the clinic SMEs;
5. Conduct training to improve HR;
6. As an information center for SMEs;
7. As a window of information and marketing for SMEs trained partners;
8. Offering services to the community, including businessmen, students, individuals, and organizations through various programs such as consulting, small business development, initiation of business, entrepreneurial counseling and training;
9. Actively involved in the development of policies to increase entrepreneurial;
10. Encourage innovation and commercialization of technology;
11. Organizing conferences and seminars, both at the national and international levels, involving parties from inside and outside the country as a process of dissemination of knowledge.

To achieve the vision, mission and also the objective from CIEL, in practice CIEL Director assisted by two coordinators in charge of two divisions in carrying out the work. The principal tasks of each division are:

1. **Division of Community Development**
Implement programs that emphasize community service, community development, training and human resource development, and encourage and increase entrepreneurial activity (figure 1).

Figure 1 CIEL Community Development

2**. Division of Education**

Conducting research in the area of innovation, entrepreneurship, and leadership which involving other Skill-Group (KK); is resulting in comprehensive research. This research studies emphasize more in application, resulting in benefits and value that can be felt directly by the public. The results of these studies should be published, to disseminate knowledge, and support and enrich the academic world.

Complete organizational structure of CIEL can be seen at figure 2 below:

Figure 2. Organizational Structure of CIEL

This study will observe the program and also performance that already done by CIEL. The data will use secondary data from CIEL from 2007 until 2010. We will see what kind of performance that already done by CIEL related with the small medium enterprise.

IV. FINDINGS

The role of higher education rather than on the provision of capital but rather on developing the ability of small industries and create a condition that drives the ability of small industries in accessing capital. Or in other words the ability of universities to foster small-scale industries in calculating the optimum capital is required, the ability to compile a funding proposal to agencies and financiers to issue a policy or regulations that favor small-scale industries in the provision of credit.

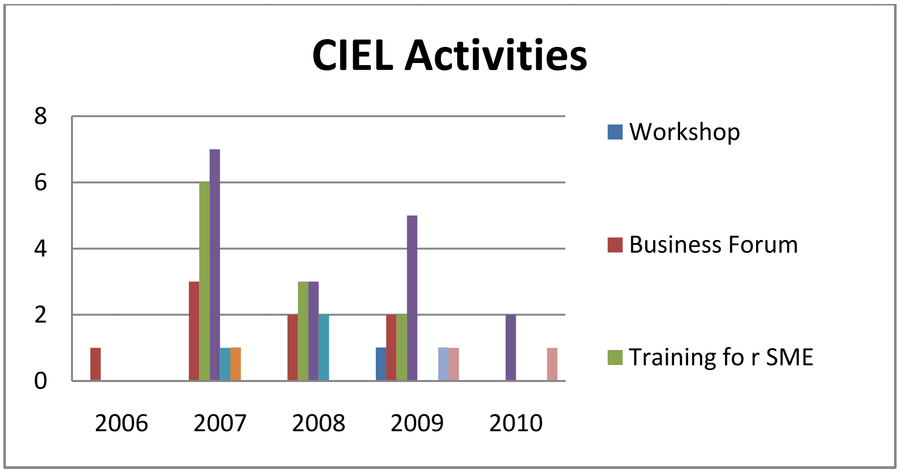

Figure 3. Activities in CIEL 2007-2010

Since 2007 until 2010 CIEL already held 34 training, 7 business forum, 1 workshop, 1 talk show and also held The 1st Indonesian Conference on Innovation, Entrepreneurship, and Small Business. According to figure 3, we can see the percentage of training that already being held by CIEL from 2007 until 2010. Year 2007 is the higher percentage, there was around 16 training related about entrepreneurship being held at that year. The lowest percentage is in year 2010, there was only 2 training being held at that year, but this also because the limited source about training record at that year. While held some training, CIEL have a different theme and topic for each of training but still have a strong relation with entrepreneurship. The participant for this training program can be a student, trained partners and SME network with CIEL SBM-ITB, and also citizen.

Beside held some training related with entrepreneurship, CIEL also held some business forum. In business forum, CIEL invited some speakers that already have an experience in held some entrepreneurship programs, such as an owner of small enterprise or a lecturer form school of business. Participants for business forum program is very wide, they are from academia, entrepreneurship, students, SMEs and partners network. According to figure 4 we can see the percentage of business forum that being held by CIEL from 2007 until 2010. Unfortunately, data in year 2010 is not available. The highest percentage for business forum is in year 2007, which is 43%. Most of the participants in CIEL activities are from SME and other participants are from high school, university student, koperasi and senior citizen forum (figure 5).

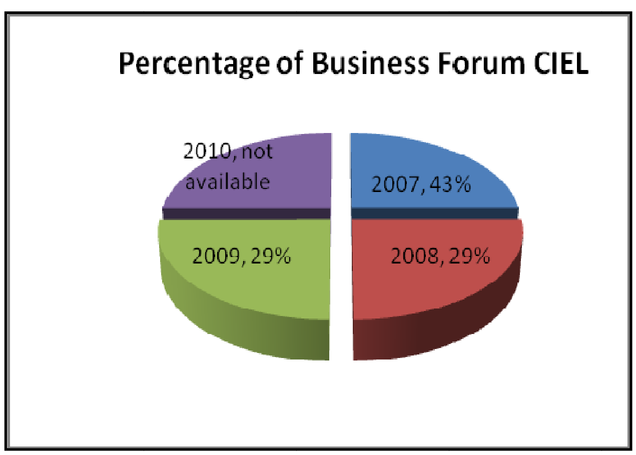

Figure 4. Chart of Percentage of Business Forum CIEL 2007-2010

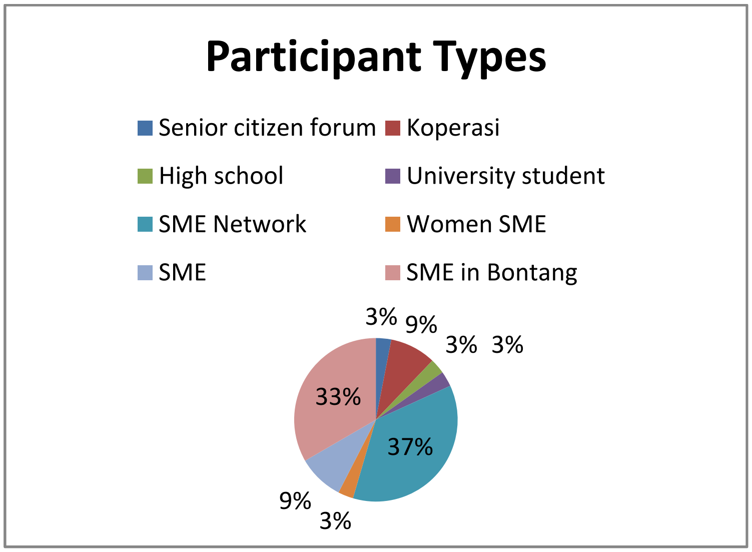

Figure 5. Participant Types

Obstacles in university and SME linkage

There was more than 200 small enterprises became a SME network with CIEL. They have a different kind of business and wide location around Bandung. At year 2007, according to figure 2 and figure 3, we can see there was a highest percentage both in held some training and also in held some business forum. But it's decline until year 2010. There is happened because, CIEL have some obstacle while do the program.

The obstacle not only came from inside CIEL but also from outside CIEL. From inside, the obstacles came from lack of the human resources. The SME that already became a network with CIEL have a very wide location around Bandung city, and because there was no feedback from SME to CIEL about their activities, sometimes member of CIEL must go there by them self. There were more than 200 SME and different location make difficulties to do some visiting one by one. Beside that sometimes the SME change their focused business into something different than their previously business. There was no agreement between CIEL and SME to have some daily report or feedback, so control of performance in each SME difficult to do.

V. UNIVERSITY AND SME LINKAGE TO STRENGTHEN SME CAPABILITY

SMEs are independent of management improvement though still need to be more focused and professional. It is important for SME to raise productivity through both investment and technological change [13]. As an illustration, a small independent industry whose market is the maximum will be given guidance in order to survive, or create product differentiation. Small industries who want to go to the middle market segment, provided guidance related to the purpose of improving the quality of products and services. Small entrepreneurs who have limited education levels will be trained with regard to the managerial aspects, and so on. Therefore, programs that are planned in the CIEL as improve the administration and accounting, human resource development staff, the legality of the business enterprise, improvement of physical facilities and infrastructure companies (such as the rearrangement of the showroom), then the future is infrastructure these SMEs can compete with other business fields. Finnally we propose some opportunity for CIEL to enhance SME capability through this linkage. There are opportunity to transfer knowledge and applied technology from ITB to SME through CIEL as university intermediary. There are also opportunity create new innovation product and also opportunity to create businesses incubator.

V. CONCLUSION

Universities are increasingly seen as essential engines of local economic development contributing to knowledge transfer processes. The type and level of interaction between academia and industry seems to be strongly dependent on SME size and the sectors in which the SME operate [12]. Higher Education as an agent of development has an obligation in the empowerment of SMEs. In general, the empowerment and development of SMEs by higher education can be done through the following ways: 1) the development and application of science, technology weapons and the practical arts is precisely the product that needs to be known and may be used directly according to the situation and the demands of community development, 2) providing expertise in identifying problems and seeking alternative solutions to scientific methods, 3) development of SMEs is done directly through entrepreneurial training, mentoring, promotion, market development, strengthening of capital facilities and so forth, and 4) action research as a joint develop a form of training appropriate to the situation and condition of the company and the community. With these measures it is believed that the empowerment and development of SMEs can be run in accordance with what we expect together. It all needs to be supported by relevant parties such as government, private and university course.

REFERENCE

[1] ______. Small and Medium Sized Enterprises: Definitions. Downloaded from http://www.lib.strath.ac.uk/busweb/guides/smedefine.htm on February 26th, 2012, 5:28 PM.

[2] ______. Small and medium-sized enterprises (SMEs), What is an SME?. downloaded from http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/sme-definition/index_en.htm on February 26th, 2012, 5:31 PM.

[3] ______. *Minimnya Jumlah Pengusaha Ancam Perekonomian*. Monday, April 9th, 2012, 10:32, downloaded from http://www.depkop.go.id/index.php?option=com_content&view=article&id=866:minimnya-jumlah-pengusaha-ancam-perekonomian&catid=50:bind-berita&Itemid=97 on April 19th, 2012, 8:14 PM.

[4] Hasanuddin, Nofri. *Peran UKM dalam Mendorong Kekompetitifan Perekonomian Indonesia*. downloaded from http://portaljakarta.com/peran-ukm-dalam-mendorong-kekompetitifan-perekonomian-indonesia on April 19th, 2012, 8:02 PM.

[5] Ramli, Nachrowi. (2010). *Keberadaan UKM*. Thursday, July 22nd, 2010, downloaded from http://koran.republika.co.id/koran/0/115619/Keberdayaan_UKM, on February 26th, 2012, 5:40 PM.

[6] Rosdiansyah. (2012). *Rapat Senat Narotama Tegaskan Kembangkan UKM*. Tuesday, February 21st, 2012, 5:48 PM, downloaded from http://www.lensaindonesia.com/2012/02/21/rapat-senat-narotama-tegaskan-kembangkan-ukm.html on April 19th, 2012, 8:15 PM.

[7] ______. (2010). *Akademisi dan Pemerintah dalam Membina UMKM Belum Menyentuh*. Wednesday, May, 19th, 2010, 1:36 PM, downloaded from http://www.pikiran-rakyat.com/node/113840 on February 26th, 2012, 5:36 PM.

[8] Wage, Wisnu. (2012). *UKM Indonesia Idealnya 2,5% Jumlah Penduduk*. February 3rd, 2012, downloaded from http://bisnis-jabar.com/index.php/berita/ukm-indonesia-idealnya-25-jumlah-penduduk on April 19th, 2012, 8:18 PM.

[9] M. Tsabit A. (2011). *Strategi Penguatan Sentra UMKM di Jawa Barat*. Saturday, March 26th, 2011, downloaded from http://diskumkm.jabarprov.go.id/index.php?option=com_content&view=article&id=169%3Astrategi-penguatan-sentra-umkm-di-jawa-barat&catid=21%3Aopini&Itemid=6&limitstart=2 on April 19th, 2012, 8:20 PM.

[10] Dessy. I, (2007), Understanding The Triple Helix Model from The Perspective of the Developing Country: A Demand or A Challenge for Indonesian Case Study? MPRA Paper No. 5829.

[11] Muscio.A, Quaglione. D, Scarpinato.M, (2011). The effects of universities' proximity to industrial districts on university–industry collaboration. China Economic Review xxx, xxx–xxx.

[12] Wright .M, Clarysse. B, Lockett. A, Knockaert. M, (2008), Mid-range universities' linkages with industry: Knowledge types and the role of intermediaries. Research Policy 37.

[13] Berry. A, Rodriquez. E, Sandee.H, (2002), Firm and Group Dynamics in the Small Medium Enterprise in Sector in Indonesia, Small Business Economics. 18, 1-3.

ROLE OF SOCIAL MEDIA IN TRIPLE HELIX TO SUPPORT A NEW PARADIGMIN THE FIELD OF TECHNOLOGY AS THE EFFICIENT AND EFFECTIVELEARNING MEDIA IN HIGHER EDUCATION

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Abstract
Social media is the tools that connect, share, and collaborate with others for various implication. Social media already been used in various application such as marketing, media and government but still higher education seems to have fallen behind in adopting and adapting to the new social media reality. In Indonesia, mostly social media used for marketing and interpersonal communication. The paper will describe about social media application as the media for learning in higher education. Case studies of technology application-education in Indonesia also will be discussed.The study uses Triple Helix Innovation to analyze relationship between academic, private sector and government. The result are social media change the learning paradigm between student and the teacher. The private sector must understand the need of their consumer if want to achieve success in design the social media in education application. The government must support a policy making for applying technology in higher education.

Keywords: Technology, social media, higher education, connectivity, collaborative.

1. Introduction

The internet is not the only thing to which the fashionable tag ‘2.0’ gets attached. We find ‘business 2.0’, ‘medicine 2.0’, ‘journalism 2.0’, and even ‘sex 2.0’. Usually this labelling device suggests that some traditional activity has now adopted a particular set of new tools. Web 2.0 tools comprise novel applications and services that run in a web browser. By invoking the language of software versioning, ‘2.0’ implies that the technology heralds a step change in what we can now do with the web (Crook, 2008)

The web 2.0 or social media’s have a capacity to enable people to connect, share, and collaborate has made its use increasingly common in the personal, business, and educational domains. Social media enables people to reconnect with former classmates and coworkers and rekindle past relationships. People share photos, videos, and provide others with frequent updates related to their lives. Further, social media facilitates collaboration for school projects, church gatherings, and community events (Safko, 2010).

Social media already been used in various application such as marketing, media and government but still higher education seems to have fallen behind in adopting and adapting to the new social media reality.Social media is more than computer application and programs and the technology behind them it is about transformation. At its core, social media is a collection of ideas about community, openness, flexibility, collaboration, transformation and it is all user-centred. If education and educational institutions can understand and adopt these principles, perhaps there is a chance for significant change in how we teach and learn in formal and informal settings. The challenge is to discover how to facilitate this change.

The main challenge seems to be the conceptual change educators need to carry out, stepping outside of traditional philosophical and socio-political frames of reference and promoting collaboration and community instead of competition in the classroom. Web 2.0's architecture of participation offers students ways of learning in formal settings that are much more congruent with our normal ways of learning and better enables them to integrate the explicit and tacit dimensions of knowledge. This technology can potentially facilitate teachers and students a more dynamic, immediate, and communicative environments that provide opportunities for meaningful experiences through social constructive learning (Bonzo, 2011).

On the other side, teacher can used social media as a teaching method to promote collaborative learning and research. Withs social media media, there is role change for teacher to guide and facilitator, helping his students to understand how to sort, understand, interpret and use the vast amounts of information they have access to. This paradigms shift offer enormous potential for advancing educational quality (Bradwell, 2009).

In collaborative research, social media facilitates a broader commons of accessible scholarly information. The proliferation of online journal access, for example, is already having tangible effects.The Research Information Network's study on e-journal use also found that per capita expenditure and use of e-journals is 'strongly correlated' with papers published, numbers of PhD awards and research grants (The Economist Intelligence, 2010).

The triple helix model was introduced by Professor Henry Etzkowitz about the importance of joining between state, industry and academia, in the economic activities to improve the regional development continuously. The Triple helix provides the ideal way for a traditional university to develop into an entrepreneurial university. Such as 'hands-on' strategy, however, requires a greater science and technology policy capacity on the part of the state, industry and academia, since the judgements of the level and type of intervention in particular areas become more critical. Therefore, the central issues are the synergy among the three different actors in societies reflecting different traditions of political economy, and different levels and types of economic development, including the macro and micro economics of each particular country (Etzkowitz et al., 2004 in Irawati, 2008).

In developing country, universities increasingly need the ability to transfer existing knowledge to lower levels on the technology scale within their societies and also to provide inputs into the development of high-level technologies that have been done through training process complemented by consulting, incubation and transfer capabilities. Therefore, the Triple Helix system places the role of the academic sphere in relation to small and medium-sized enterprises to engage in joint networking with other supporting institutions.

The relations between triple helix model as innovation in education is how the potential of social media users are very high in Indonesia can be used in the education sector because so far only used in social media marketing, interpersonal communication and so forth. For students, social media can be an exciting means for them to learn. For educators, social media can be a tool for collaborative teaching and educational collaboration. For universities, social media can be a means to improve the quality of their educational institutions. For the entrepreneur, social media applications in education can be a product that meets customer and source of income and for the government, how social media can be a means of learning the intellectual life of the nation (Miron, 2008).

As an illustration, the number of internet users in Indonesia in 2011 stood at 55 million people. An increase of 13 million people compared to the year 2010. If we look Indonesia population of 240 million people in Indonesia, internet penetration has reached 23%. This number is expected to continue significantly in coming years when the internet is becoming very affordable by the population of Indonesia (Digital Media Asia, 2011).

The use of social media for education already begun in Indonesia with edu2000.org and Giga-mmh.org. The edu2000.org is a sites aims to provide educational content with virtual community facilitates discussion, staff and alumni. The Giga-mm.org is a sites with mission is to provide enhancement in education, empower smaller business, and speed up science and technology dissemination. Specific activities of the NGO are publishing Giga magazine, maritime research and video documentations of various aspects of socio-cultural heritage in Indonesia.

Until now, numerous scientific papers describing how to use social media as a teaching tool in higher education but there is no papers that tries to portray not only the social media as an educational innovation, but also describes the interaction of relevant stakeholders with social media in higher education such as universities, corporation and government.

The importance of this paper is to enrich the scientific study of how social media as a innovative tool for education. In addition, this paper can also be helpful for decision makers to understand how social media can be used for education so as to make adequate planning for implementation.

This paper will explore social media and higher education in particular how social media can be used as a tool to improve the quality of education and the changes that occur between students, teachers, university, government and business sector. Also, we will take a look about social media in Indonesia dan Indonesia educational sites.

2.Social Media

According to Safko (2010) social media is the media we use to be social. The first part of the terminology, social refers to the instinctual needs we humans have to connect with other humans. We have been doing that in one form or another since our species began. We have a need to be around and included in groups of similar like-minded people with whom we can feel at home and comfortable sharing our thoughts, ideas, and experiences. The second part of that term refers to the media we use with which we make those connections with other humans. Whether they are drums, bells, the written word, the telegraph, the telephone, radio, television, e-mail, web sites, photographs, audio, video, mobile phones, or text messaging, media are the technologies we use to make those connections.

The application of the terminology social media is about how we can use all of these technologies effectively to reach out and connect with other humans, create a relationship, build trust, and be there when the people in those relationships are ready to purchase our product offering.

Social media's capacity to enable people to connect, share, and collaborate has made its use increasingly common in the personal, business, and educational domains. Social media enables people to reconnect with former classmates and coworkers and rekindle past relationships. People share photos, videos, and provide others with frequent updates related to their lives. Further, social media facilitates collaboration for school projects, church gatherings, and community events. In business, social media is useful for virtual marketing, which makes word-of-mouth advertising that much easier. Social media provides new approaches for entrepreneurs who wish to reach niche markets, as well as customers who wish to share their evaluations of and recommendations for new products.

Social Media Categories

Crook (2008) described in a broad sense, "social networking" encompasses many popular web-based tools for sharing information and connecting with other Internet users. Here are some of the most popular Web 2.0 tools:

- **Blogs** (web logs) started as personal journals. A blog in its most generic sense is a website that is updated on a regular basis, displays the content in reverse chronological order (newest entries first), and allows, even invites, reader response. Through RSS feeds or by e-mail, blog updates are easily tracked. Technorati, a web site devoted to blogs, estimates there were more than 77 million blogs in 2008. Of all Web 2.O tools, blogs are among the most used by teachers who bring the read/writeable Web into the classroom.
- **Wikis** are tools that let many individuals write and edit text together. The wikis store revisions and track who wrote or edited them. Various versions can be referred to or restored anytime. Unlike blogs with separate "feature" and "comment" spaces, edits on wikis appear within the main body of the text. The most popular wiki is Wikipedia, a user-edited encyclopedia that rivals traditional ones for accuracy and is wildly popular with all ages. Wiki created reference, travel, and curricular materials (Curriki) are growing in popularity. Tools like the free pbwiki and Wikispaces offer educators ad-free wikis that have limited access and control settings. More robust versions are available for a monthly fee.
- **Social bookmarking** sites such as Delicious allow users to share their Internet bookmarks and create descriptive "tags" to help organize the site's resources. Flickr lets users share their photographs and create descriptive "tags" to help organize and find them; YouTube and TeacherTube allow video sharing and tagging. News readers like GoogleReader allow users to easily track and share the often changing web content of blogs and mainstream news sites that have RSS feeds.

- **Cloud-based productivity tools** allow multiple authors to create and edit word processing documents, spreadsheets, and multimedia presentations without any desktop application other than a web browser. These creations can be stored and share online or locally. GoogleDocs and Zoho are among the more popular tools of this type.
- In **3-D virtual environments** like Second Life and Teen Second Life users create avatars, pictorial representations of themselves, and explore these worlds. They converse with other avatars, participate in their economies, create habitats, and attend events, some educational. Club Penguin and Webkinz are virtual environments aimed at elementary-age children.
- **MMORPGs** (Massively Multi-Player Online Role Playing Games) such as World ofWarcraft and Everquest require that players work collaboratively to accomplish missions and win competitions.

Internet in Indonesia
The number of Internet users in Indonesia in 2011 this has reached 55 million people, an increase from the previous year in number 42 million. Compared to the population of the country which is about 240 million people, that means 23% Indonesia has a 23% Internet penetration rate and it is dominated by big cities—only 4.1% located in rural area . These numbers are expected to rise significantly in the years to come as technology becomes more affordable. The number of people who use mobile devices reached 29 million people. It means that more than 50% internet users in Indonesia use mobile devices to browse on the internet (Digital Media Asia, 2011).

Internet Technology Overview
Infrastructure is lacking in the rural areas of Indonesia, due to the country's fragmented geography. This may delay the growth of Internet subscribers slightly. The broadband market is an area with immense growth opportunities with both fixed and mobile broadband technologies. Next-generation technologies in mobile broadband are also able to partially circumvent the fixed technologies required by Indonesia's fragmented geography.With the current broadband penetration rate stands at 2.2% at the end of 2011, the Indonesian government is seeking to increase the penetration rate to 30% by 2014. This push for broadband penetration is found on a US$9.2 billions plan. Investments in technology with more WiMAX services and commercial LTE will continue to improve broadband connections in the country (Digital Media Asia, 2011).

Table 1: overview of Internet users in Indonesia (in millions)

Indonesia	2005	2006	2007	2009	2010
Personal Computer	3.285.0	4.510.0	4.893.8	5.700.0	6.119.8
Internet User	7.896.9	10.575.7	13.000.0	20.000.0	28.406.6
Internet Subscriber	1.853.0	2.543.6	3.126.0	4.483.6	5.142.4

Source: Digital Media Asia, 2011.

Internet User Demographics
According to the Yahoo! and TNS Net Index of Indonesia in 2010, internet users tend to be youth of higher social and economic status. However, youths of lower social and economic status are quickly catching up. The trend of increasing Internet use is present in cities beyond the capital of Jakarta. At the same time, Indonesians' reliance on Internet cafes or Warnets is decreasing as the prices of personal computers and home/mobile internet continue to fall (Digital Media Asia, 2011)

Activities Online
The preferences for online activities are shifting. Social networking is gaining ground due to the popularity of Facebook and Twitter. Research from Firefly Milward Brown describes social media in Indonesia as a tools for establishing one's social status in the form of recognition and admiration. Social media is also used for sharing and bonding (Digital Media Asia, 2011)

SOCIAL MEDIA TOOLS IN HIGHER EDUCATION
According to White, King, Tsang (2010) in Social Media Tools And Platforms In Learning Environments, there are several social media tools in education can be used in learning such as:

Remembering with Social Bookmarking

Remembering is defined as "retrieving, recognizing, and recalling relevant knowledge from long-term memory" (Anderson and Krathwohl 2001) in White, King, Tsang (2010). Social bookmarking is a magnificent tool used to remember and organize online resources. They provide students and teachers with the ability to save website links to one location, accessible through the Internet. These links allow the students and teachers to easily find the site in the future. Examples of social bookmarking sites include: EdTags, Delicious, Google Reader, and Diigo. As Churches, Crockett and Jukes. (Churches et al. 2010) in White, King, Tsang (2010) note: Using social bookmarking tools, students and teachers are able to harness the huge potential of the Internet's resources by collaborating and sharing sites they have found and validated. The easy accessibility of social bookmarking tools means you can access and search your bookmarks from any computer connected to the Internet. Students are easily able to collaborate with their peers and teachers, which contributes to the learning process and validates their research process (p. 33).

Ideas for Social Bookmarking in the Classroom

- Depending on the class topic (science, math, literature. . .), the student should research the internet and bookmark related links.
- Play Jeopardy using social bookmarks. Give the students a topic and have them work alone to bookmark related links. Next, commence playing, using general statements that should be found on a website. For example, the topic can be the United States and a potential Jeopardy answer could be "This state has the largest population."
- For a student government class, the students use social bookmarks to identify links to debatable topics (websites for gun control and websites against gun control).
- For each new topic, teachers share a new collection of online resources.
- Teachers use social bookmarking to subscribe to RSS feeds to bring the news to one designated location. At the beginning of each class, the teacher can scroll through the new headlines and work with the students to tie a link between the news and the class topic.

Understanding with Social Blogging

Understanding includes "constructing meaning from oral, written, and graphicmessages through interpreting, exemplifying, classifying, summarizing, inferring,comparing, and explaining" (Anderson and Krathwohl 2001)in White, King, Tsang (2010). Blogs are an efficientmethod to learn what is known about a specific topic and bring forward new ideas.Typically, blogs are updated and maintained by an individual, rather than a company.Blogs can provide information through writing, pictures, videos, music,and/or audio. Examples of blog publishing tools include EduBlogs, Learner-BlogWordpress, Google Blogger, Tumblr, and PhotoBlog. Specific to education,
Richardson (Richardson 2010) suggests: adopters of Weblogs in the classroom have already created a wide variety of ways to usethem, and they have shown that blogs can enhance and deepen learning. Even at thisstill fairly early stage of development, blogs are being used as class portals, online filingcabinets for student work, e-portfolios, collaborative space, knowledge management, andeven school Web sites. Through the unique process of blogging, students are learning toread more critically, think about the reading more analytically, and write more clearly.Further, they are building relationships with peers, mentors, and professionals within theWeblog environment (p. 20).

Ideas for Social Blogging in the Classroom

- Students use blogs to summarize concepts, articles, and notable resources usedwithin the classroom.
- Teachers use blogs for class management. They help their students understandclass requirements better, through posting class assignments, handouts, and byproviding a forum for answering questions.
- E-portfolios, summarizing the breadth of a student's work, are created usingblogs.
- Blogs are a wonderful tool for students to debate a current topic of interest.
- Teachers use blogs as a way to communicate with parents about computer-usepolicy, external resources, lesson plans, and class events.

- Teachers have students create a bucket list for the semester – 10 things toaccomplish by the end of the semester. Students follow up and summarize theaccomplishment with pictures, videos, or writing.
- Teachers challenge students to a food diary, taking a picture of every meal eaten.
- Students create a photoblog – one picture a day for the entire semester.
- Students use blogs as a means of creating a daily response and reflection fora book the class is reading. The students read and respond to each other'sblogs.

Applying with Social File Sharing

Applying includes "carrying out or using a procedure through executing, or implementing"(Anderson and Krathwohl 2001)in White, King, Tsang (2010). Social file sharing tools are a new wayto share information about a specific topic. Examples of social file sharing toolsinclude: Moodle, Google Documents, Wikis, and Keep and Share. Specific to theclassroom, Solomon and Schrum (Solomon and Schrum 2010)in White, King, Tsang (2010) suggest:Imagine this situation: You and your colleagues create a paper, presentation, or report. Youpass the file around, each adding the date or your initials, or both. After several iterations,you are not really sure which is the latest version, whose tracking or changes have beenaccepted and incorporated, or who has made the final decisions on the document. Butassuming you end with the correct version, you show up with your thumb drive only todiscover that the best version is not the one you have with you! The correct one is really onyour home computer or on the thumb drive in your other coat pocket! If this has happenedto you, or you know someone for whom this occurred, you might begin to understand thelure of Google Docs (p. 68).

Ideas for Social File Sharing in the Classroom

- Google Documents, through spreadsheets, are used as a way to teach probabilityand statistics. Up to 50 users work on one spreadsheet at a time. In class,users can simultaneously enter data, and the class can then perform statisticalanalysis.
- Wikis are used to brainstorm new ideas about class projects or debate a hot topic.
- Students work on collaborative projects through file sharing programs.
- Through file sharing programs, the teacher sees exactly who wrote what, todetermine project contribution.
- Teachers use file sharing programs to easily share document templates withstudents.
- File sharing programs create a forum for parents to view and check up onstudent's work.
- Teachers assign students to edit/comment on each other's documents throughthe file sharing programs.
- Students use file sharing to fill out a document asking questions about a bookreview or other topics of interest.
- File sharing programs allow teachers to easily keep track of grades, attendance,and other data for students to review.

Analyzing with Social Collaboration

Analyzing includes "breaking material into constituent parts, determining how theparts relate to one another and to an overall structure or purpose through differentiating,organizing, and attributing" (Anderson and Krathwohl 2001)in White, King, Tsang (2010). Social collaborationtools allow groups to meet, discuss, mark-up, and analyze information in onespecific playground or workplace. Examples of social collaboration include ePals,Dim Dim, Oovoo, Skype, and Twiddla. Solomon and Schrum (Solomon and Schrum2010) in White, King, Tsang (2010) argue: teachers and other educators have begun using these tools for a variety of activities, and asthey become more familiar, they see other ways for students to benefit from them. Ingeneral, the goal and purpose has been to make public the types of development, creativity,and other activities that their students typically do individually. These tools have alsoafforded educators a way in which to promote and encourage collaboration authentically inthe development of projects and papers (p. 69).

Ideas for Social Collaboration in the Classroom

- Teachers use social collaboration tools to establish virtual classrooms.
- Parent–teacher conferences are achieved using social collaboration tools.

- Social collaboration tools provide a permanent location for distance learninggroups to meet about class projects.
- Twiddla is used to increase the functionality associated with collaboration,including screen mark-ups, chat, and a real-time whiteboard.
- Skype allows distance learning student groups the ability to analyze projects andsuggest alternatives.
- If students are unable to participate in a fieldtrip, Skype is used to bring thefieldtrip to the students.
- Social collaboration tools are used to virtually bring guest speakers to theclassroom.
- Social collaboration tools are used to bring special needs kids into the classroom.
- ePals provide students the ability to create pen pals across the globe and learnabout other cultures.

Evaluating with Social Decision Making

Evaluating is defined as "making judgments based on criteria and standards throughchecking and critiquing" (Anderson and Krathwohl 2001)in White, King, Tsang (2010). Social decision-makingtools are used to evaluate new ideas, consider multiple options, and gain generalconsensus through crowd sourcing. Examples of social decision-making tools include:Kluster, Doodle, and User Voice. The Kluster website states the benefit of this tool:Kluster is a collaborative decision making platform — a turbo-charged collective wisdommachine that turns questions into answers, ideas into opportunities, and analysis into action.Unlike conventional "crowdsourcing" that pits people and ideas against each other, Klusterbrings them together. Our approach is based on real-world group decision-making models,taking into account individual influence and participation. Not only does Kluster identifythe best ideas, it actually improves them in the process (Kluster.com).

Ideas for Social Decision Making in the Classroom

- Teachers use social decision-making tools to poll the class on upcoming bookoptions.
- Student groups use social decision-making tools to aid in project selection.
- Social decision-making tools are used to brainstorm and select a best idea.
- Students use decision-making tools to judge each other's science projects.
- For a management class, students use Kluster to gain feedback on new productdevelopment or business ideas.
- Social decision-making tools can aid in the class project evaluation processthrough prioritizing objectives and project components.

Creating with Social Creativity Sharing

Creating is described as "putting elements together to form a coherent or functionalwhole; reorganizing elements into a new pattern or structure through generating,planning, or producing" (Anderson and Krathwohl 2001)in White, King, Tsang (2010). Social creativity sharingsites are an exciting venue through which users can share videos, pictures, andpersonal publications. Examples of social sharing sites include: video sharing(YouTube, Metacafe, and uvouch), picture sharing (Flickr, Photobucket, Snapfish),and publishing (Scribd, Writeboard, Pixton).

Ideas for Social Creativity Sharing in the Classroom

- For a show and tell, using a video camera, the students create a demonstration(science experiment, cooking video, dance lesson) and post to a video sharing site.
- If students go on vacation, ask themto create a video and post to a video sharing site. The teacher creates a video demonstration of a science experiment and posts to avideo sharing site. Thus, if students have questions, they can just refer to the video. If several students are absent from class, the teacher can videotape and post thelectures.
- Students join forces with a local nonprofit and post a photo album of events toa picture sharing site.
- Students use Pixton to create a cartoon depiction of their feelings towardsomething they like or dislike, relative to the class topic.

- Students use Scribed to collaborate on a writing project, where participants taketurns writing without editing. Thus, each person needs to keep the story flowingbased on the writings of the previous person.
- Have students research colleges or potential employers through the use ofvideo sharing and picture sharing sites. Then have the students create a videoto promote the specific class.
- For a class topic on recycling, have students create a photo album with picturesof common household products that are recyclable.
- Students can use Scribed as a source for brainstorming class project ideas in onecentral location.

Communicating and Relationship Building with Social Networks

Revisiting Bloom's Taxonomy, the previous six thinking objectives focused almost exclusively on the cognitive domain. However, another important domain for students is the affective – or emotional – domain, which includes communication and relationship building. The ability to effectively network and build relationships is critical to both personal and professional success. An individual's social network includes the individuals with whom that individual maintains relationships, including colleagues, friends, family, and other social contacts.

Online social networks, however, can transcend traditional geographic and time-zone limitations. For example, Facebook, Second Life, LinkedIn, Edmodo, and Ning allow individuals to access the network regardless of location and time. Specific to education, Bunzel (Bunzel 2010) in White, King, Tsang (2010) writes: At the time this is being written, Twitter is extremely hot and is the most significant real time social media communications tool. "Real time" refers to the immediacy of Twitter's status updates and the responses of followers; because of the brevity of posts, there is almost no lag time between a post and a slew of responses, a viral dissemination of information and opinion. . . . But at the moment, Twitter is an important tool for seeing how quickly social media can effect of the outcome of communications strategy, how it comprises a key component of your online identity, and how you interact and are perceived by others (p. 110–111).

Ideas for Social Networks in the Classroom

- Through SecondLife, institutions purchase "land" to build and develop structures,and the environment, to create a meeting place for students.
- Students join forces with a local nonprofit and create a fan page in Facebook topromote a cause. Pick teams and make it a competition to see how many peoplewill "Like" the page.
- Host a class discussion using SecondLife.
- For a marketing class, using Ning, the students create a social network centeredon a specific product or service and connect with others to gain feedback.
- Have students debate an ethical topic using Facebook and writing on a wall. Using LinkedIn, a student may connect with professionals and use their contactsto get a guest speaker in the classroom.
- For a management class, students work in teams to create a business plan usingSecondLife to offer a new service in this alternative world.
- For a literature class, have students make an avatar, using SecondLife, basedon specific characters in the literature. Then, the students meet in SecondLife toplay out the different roles.
- Teachers, students, and parents can stay connected using the different socialnetworks to stay up-to-date on student progress.
- For a law class, teachers use social networks to teach students about privacy. Thestudents read and discuss the different privacy options.
- Facebook etiquette is a great topic for discussion prior to implementing thesocial media.
- Teachers use social networks to offer a question and answer session prior totaking a test.
- Students use Facebook as a forum for posting book reviews and movie reviews.
- Students use Facebook, through an Event or Fan Page, to organize a communityservice project.
- Facebook offers a wide variety of educational applications. For example, througha quiz application, the students create quizzes for each other to assist in studyingfor an upcoming exam.
- Twitter is used to follow famous people (CEOs, president and other politicalpeople) to keep current on changes.

- Teachers use Twitter to keep the students updated with information pertaining toabsences, upcoming exams. . .
- Conduct a quantitative study, using probability and statistics, on the type ofinformation tweeted online.
- Teachers use Twitter to focus on writing skills, as tweets are limited to 140characters.
- Prior to an exam, host a recap quiz where the first student to tweet the correctanswer gains a bonus point on the exam.
- Use social information networks to easily find popular articles related to theclass topic.

Web 2.0 And Education
Technology Application for Higher Education

Technology is enabling multi-modal teaching, changing curricula and spawning rich forms of online research and collaboration. Nearly 60% of survey respondents about Future of Hihger Education conducted by The Economist Intelligence Unit say that professors will soon teach in more than one medium. At NYU's top-ranked tax law programme, for instance, classroom courses are filmed with three cameras and a sound mixer. When asked to compare different communications technologies, 52% of survey respondents state that online collaboration tools would make the greatest contribution in terms of improving educational quality over the next five years—the top response—while 48% point to the dynamic delivery of content and software that supports individually paced learning. Sophisticated learning-management systems and enhanced video and presentation tools are among other innovations that respondents say are likely to have a profound effect on the academic experience.

It is interesting to note that despite the growing array of technology-enabled teaching tools available, nearly three-quarters of participants say that the greatest potential benefit of technology is something far more straightforward—namely, the expanded access to educational and reference resources that it provides.

According to the survey results, online-collaboration tools, software that supports individually paced learning, and learning-management systems are among the communications technologies most expected to improve academics over the next five years. Web 2.0 technologies such as wikis, instant messaging and social networking—which have been influential in improving connectivity in many settings and are in use now at a large number of institutions—are expected to decline in use over that period. By contrast, online gaming and simulation software are cited by 54% of higher-education respondents and 59% of corporate respondents as an innovation likely to be adopted among universities over the next five years. Faculty members, administrators and CIOs are also exploring how web applications and freeware such as Google docs can improve efficiency and reduce costs (The Economist Intelligence Unit, 2008).

The New Ways Of Knowledge Engangement

Grant el al. (2006) stated that at least three fundamental shifts in thinking about the relationship among knowledge, culture, learning and pedagogy. The modes of inquiry encouraged by Web 2.0 practices tend to be less oriented to the traditional disciplinary boundaries of knowledge. The learner is invited to adopt a conception of knowledge as something available to be personalised or reappropriated.

Web 2.0 encourages engagement with knowledge in new ways. For instance, it encourages a more animated browsing and scanning orientation. The practices of knowledge production are being altered. In particular, learners are being drawn into inquiry methods that are more collaborative and less solitary. The collaborative spirit and open ethos of the activities outlined above, and many others like them, are often combined into a prevailing sense that Web 2.0 has created greater opportunities for access, debate and transparency in the pursuit of knowledge than ever before.

Discourse about technology in education point to the evolution and transformation in transcending formal educational contexts. Evolution in facilitating more informal and non-formal learning context which blurs the bounders between categories of learnes. Learners are now able to become more active producers, authors, evaluators and commentators within the learning arena they are engaged with. The building, but also to foundational issues that will affect educational institutions and practice question then directs attention to the novel paradigms of learning and for knowledge for the future.

New Form Communication And Collaboration

Social networks enable new forms of communication and collaboration. The importance of collaboration is a common ingredient in many of the learning perspectives, as it is generally considered to be an important means of developing understanding through shared dialogue and co-construction. An ecology of social networks has now developed, ranging from those congregating around common interests or kinship, through to those associated with more formal community contexts (such as formal learning contexts or professional networks.

Mason and Rennie (2008) accept Siemens' (2004) in Conole and Alevizou (2010) proposition that Web 2.0 methods and tools permit the educational process to transcend constructive theories by moving from isolated, individual activities to interactive exchanges amongst a community of collaborating learners (i.e., collaborative constructivism, or connectivism, puts an increased emphasis on involving the student in active participation and in the process of learning). Siemens (2006) in Conole and Alevizou (2010) places the network and networking in the centre of the learning process. This 'net-centric' perspective sees knowledge not necessarily as a progressive accumulation, but rather as a process for building, maintaining and utilising connections.

These ecologies are facilitated by a range of processes of engagement instantiated through the new technologies, making peer guidance, reflection and support possible in a variety of new ways and at a scale not seen before. For example, the ability to openly comment upon and critique other people’s work has become a standard practice within the blogosphere and has been taken up by academics (through self-reflective blogs for teaching and digital scholarship) and researchers. In teaching contexts, students can socialise with peers through social networks, providing mutual support and a forum for shared dialogue (Conole and Alevizou, 2010).

Social Media For Student

Social media constitute an increasingly important context wherein individuals live their everyday lives. Indeed, some commentators talk of the ‘networked self’—acknowledging the importance of social media as a key site of sociality and identity performance in many people’s lives (Papacharissi, 2010). As such, the most immediate significance of social media for higher education is the apparently changing nature of the students who are entering university.

In a practical sense, the highly connected, collective and creative qualities of social media applications are seen to reflect (and to some extent drive) more flexible, fluid and accelerated ways of being. Social media are therefore associated with an increased tendency for young people to multitask, to rely on a ‘digital juggling’ of daily activities and commitments (Subrahmanyam and Šmahel, 2011) in (Selwyn, 2011).

More subtly, these technologies are also associated with an enhanced social autonomy—with young people now used to having increased control over the nature and form of what they do, as well as where, when and how they do it. Indeed, social media users are described as having an enhanced capacity to self-organize and provide for themselves. The learners' need to create meaning requires a balance between autonomy, the ability to learn independently based on a process of interpretation and meaning-making of a variety of experiences (Jonassen, 1991), and community, the context where this meaning is ultimately created through social interaction (Duffy and Cunningham, 1996) in (Frias and Montano, 2010).

Social Media For Teacher

The single issue here is the role of the tutor. Tutors are central to development of approaches to learning and teaching in higher education. They have much to keep up with, their subject for example, and developments in their craft – learning and teaching or pedagogy. To practise effectively, they have also to stay attuned to the disposition of their students. This is being changed demonstrably by the nature of the experience of growing up in a digital world. The time would seem to be right seriously and systematically to begin the process of renegotiating the relationship between tutor and student to bring about a situation where each recognises and values the other's expertise and capability and works together to capitalise on it. This implies drawing students into the development of approaches to teaching and learning.

Higher education has a key role in helping students refine, extend and articulate the diverse range of skills they have developed through their experience of Web 2.0 technologies. It not only can, but should, fulfil this role, and it should do so through a partnership with students to develop approaches to learning and teaching. This does not necessarily mean wholesale incorporation of ICT into teaching and learning.

Rather it means adapting to and capitalising on evolving and intensifying behaviours that are being shaped by the experience of the newest technologies. In practice it means building on and steering the positive aspects of those behaviours such as experimentation, collaboration and teamwork, while addressing the negatives such as a casual and insufficiently critical attitude to information.

The means to these ends should be the best tools for the job, whatever they may be. The role of institutions of higher education is to enable informed choice in the matter of those tools, and to support them and their effective deployment (Conole and Alevizou, 2010).

Collaborative Teaching

Social media tools enable *collaborative* teaching. Michael Wesch from the University of Kansas experiment a collaborative learning in higher education. He used social media as a teaching method to promote collaborative learning and research. He does this by using online tools to make student coursework team-based and collaborative. The result is there is change for teacher to guide and facilitator, helping his students to understand how to sort, understand, interpret and use the vast amounts of information they have access to.

Collaborative research

We can now see the tangible and significant effects of the new collaborative technologies as people find ways to create and find information and ideas, and connect with people to get things done. Only recently this would have seemed the vague wishes of a techno-utopian. In the pamphlet *Network Citizens*, Demos reported that companies reap huge benefits from finding ways to capitalise on networks of people who may not formally sit within their organisations. Collaboration has had an immediate impact on research, since researchers have found the tools to develop their existing propensity to work together. That has seen the emergence of virtual research communities, which are helping collaborative research flourish (Bradwell, 2009).

Web 2.0 And Indonesian Education Sector

The Ministry of Education in Indonesia has a central website (http://www.jardiknas.net) listing various educational websites both from within the Ministry as well as external websites.

Edu2000.org site is one such website combining web2.0 and education. Edu2000 aims to provide educational content as well as build an online community around education with the motto "Finding, creating and sharing educational content". Most of the content is shared in the form of videos, which are classified and organized in web pages with a preface or comments by teachers. Topics range from Alexander the Great in history to organic farming. The formation of this virtual community facilitates discussion between students, staff and alumni.
According to Kosasih Iskandarsjah, founder of Edu2000.org. (2004), the concept of edu2000.org is sharing therefore other school can access materials from other school, except they wish not to do so. Also, once the local materials ready, then only membership schools can access the materials with samples will be provided for public.

Education material can be obtained from the Internet through search engines, directories or other means. Education material can be obtained also by subscribing to databases such as those offered by EBSCO to schools. The education material are materials or work complements and discussion of teachers, students or parents to improve an educational materials, educational materials that are not on the curriculum. The format should not only be in writing, unless it can be in the form of audio, video, photos, illustrations, even in the form thread in archives and mailing list or online forum.

When each teacher to complete an experiment video from most all occupied, there will be dozens or even millions of teachers with a variety of video 'best' from a variety of experiments. Without collaboration, the teacher has only one video 'best' own workmanship. But when there collaboration sharing, the teacher (and other teachers) will have a collection of thousands, tens of thousands, or even many very valuable educational videos. Similarly with other educational materials such as photographs, illustrations, short essay, or a Java applet that illustrates the concepts outlined certain confidential when only the words (for example the concepts in Chemistry).

Currently 353 members for the school website in which about 30 are teachers and the rest are students. Most of those who have signed up are mostly the final year students (Grade 9). Kosasih mentioned that social media in Indonesia is slowly picking up as internet speed is improving and internet rates are more affordable. Currently, most of the Internet access is from schools, offices and internet cafes.

Other Indonesia sites that involved in education is giga-mmh. Org. Giga-mmh.org mission is to provide enhancement in education, empower smaller business, and speed up science and technology dissemination. Specific activities of the NGO are publishing Giga magazine, maritime research and video documentations of various aspects of socio-cultural heritage in Indonesia. In education, giga-mmh.org is active in education enhancement in various schools (elementary, middle, high, and vocational), providing extra-curricular activities, seminars, exhibitions, science tours, publishing school gazettes, and assisting students for science competitions.

Giga-mmh.org also develops various educational kits. Together with local regency governments, giga-mmh.org coordinates activities in providing information, business opportunities, and co-operation between underdeveloped regencies with advanced productive regencies.

A Glance of the Triple Helix

The triple helix model has been said to be positive synergy among the three different actors in knowledge spillovers. The model engages the university as the centre of excellent with its academic-based research and development activities, industry as the provider of the customer demand based on its commercial activities as well as research and development, and the government as a policy maker. The integration of these different actors lies at the heart of the triple helix system that ideally will increase knowledge spillovers in the region; thus, increasing the competitive advantage of economic development, either regional or national.

The triple helix system was introduced by Professor Henry Etzkowitz who studied the importance of joining these three different actors in the economic activities to improve the regional development continuously. The Triple helix provides the ideal way for a traditional university to develop into an entrepreneurial university. Such as ‘hands-on’ strategy, however, requires a greater science and technology policy capacity on the part of the state, industry and academia, since the judgements of the level and type of intervention in particular areas become more critical (Etzkowitz et al., 2004). Therefore, the central issues are the synergy among the three different actors in societies reflecting different traditions of political economy, and different levels and types of economic development, including the macro and micro economics of each particular country.

In developing country, universities increasingly need the ability to transfer existing knowledge to lower levels on the technology scale within their societies and also to provide inputs into the development of high-level technologies that have been done through training process complemented by consulting, incubation and transfer capabilities. Therefore, The Triple Helix system places the role of the academic sphere in relation to small and medium-sized enterprises to engage in joint networking with other supporting institutions.

Related to the requirements of the new economy education becomes a system of integrated activities in which people learn how to learn and, also, learn how to operate with the knowledge they have, consolidating and developing it. The change that arises in the mission of the contemporary education system is, essentially, related to the extremely dynamic process of renewal and restructuring of scientific knowledge in all fields. There is no logic in education requiring people to learn things that are inevitably doomed to change. What education is required to deliver are methods of learning and internalizing viable and durable cognitive structures and practices (Miron, 2008).

ROLE OF UNIVERSITIES IN SOCIAL MEDIA AND HIGHER EDUCATION

As a social institution that has traditionally served to develop science and technology, university are institutions that most feel the social demand for such global changes. Businesses, governments and communities that need a new science-based information technology, biotechnology and other multidisciplinary sciences will require universities to meet their needs for science and technology higher.

In today's technology-enabled knowledge economy, many universities find themselves facing a new challenge: how not only to equip students with an adequate education in their field of study, but also to arm them with the skills and knowledge required to leverage technology effectively in the workplace.

According to Bradwell (2009), if we plan to apply technology to universities, we have to make sure that technology isn't just something that means you build a room full of computers on your campus. Technology is at the heart of this story of institutional change. Universities are now just one source among many for ideas, knowledge and innovation. That seems to threaten their core position and role, but in this new world of learning and research, there are also great opportunities. The internet, social networks, collaborative online tools that allow people to work together more easily and open access to content are both the cause of change for universities, and a tool with which they can respond.

This is driven by people finding new ways to access and use ideas and knowledge, by new networks of learning and innovation, and by collaborative research networks that span institutions and businesses. It is an increasingly international phenomenon. Across the globe, countries are pushing for greater advantages in education and innovation. There is an ever growing environment of learning, research and knowledge exchange of which universities are one part.

Experience shows that, when institutions make good quality courses and materials publicly available online, they can attract new students, expand their institutional reputation and advance their public service role. Such institutions may also further the dissemination of research results and thereby attract research funding. However, institutions have to position technology within their institutional branding and take into account any income that the sales of their educational materials may generate.

The challenge is to get the relationship between the institution and the technology the right way round. Open repositories of online content, social media networks like Facebook and the use of virtual learning can all help universities provide more flexibility and new ways for people to access scholarly and research material. Technology can help universities move from where they are now to where they need to be. This will require a commitment to open content and shared resources, and investment in the management and curatorship of vast amounts of data and knowledge. It will also mean offering new kinds of courses, accreditation and affiliation that use informal learning and research networks and connect them to the formal system (Bradwell, 2009).

ROLE OF PRIVATE SECTOR IN SOCIAL MEDIA AND HIGHER EDUCATION

Survey from The Economist Intelligence (2008) describe that university research and development departments may once have been the primary arena for testing new tools and theories, reveal that corporations now have the edge in adopting new innovations. Domestic academic institutions must collaborate with companies to develop and implement new technologies. This corporate-university partnerships will play a pivotal role in future innovation and research excellence.

Perhaps as a consequence, recent years have seen a surge in research-driven public- and private-sector relationships. Today's students are used to getting what they need instantly. Universities have to respond to remain competitive, but those innovations often cost millions of dollars. How to fund those investments appropriately is on the top of everyone's mind. Money is part of the issue.

As more and more universities look to the private sector to support and extend technological advances, companies can be selective in choosing partners. Ninety-three percent of private-sector respondents say that the quality of a university's technology will be a significant factor in their collaboration.

The CIO of University of Melbourne, Linda O'Brien stated that they has been working closely with a leading global technology company with cooperation from research to scholarship. Money it's not the issues but it's about leveraging the different strengths that partners can bring. There's a growing realisation that partnering can drive better results for both parties. As a research-driven institution, we see partnering with research or private-sector institutions as a mutually beneficial means of boosting not only economic prosperity, but social prosperity as well (The Economist Intelligence 2008).

The participatory web means using the web collaboratively and interactively. Google seems to understand this and has built their business to reflect interactivity and collaboration. Instead of fighting the winds of social media, they have decided to sail along and harness the social winds. Google's approach has not been to force people to use their tools as Google thinks they should be used. Rather Google has built the tools, which allows the users to use the tools as they believe will benefit them. This is a grassroots way of doing things (Bonzo, 2011).

ROLE OF GOVERNMENT IN SOCIAL MEDIA AND HIGHER EDUCATION

The roles of governments in higher education and the relationships of governments with institutions in this sector vary widely from country to country. However, governments can usually play an important role in setting policies for higher education systems. They have an interest in ensuring that public investments in higher education make a useful and cost-effective contribution to socio-economic development. Most governments also support some universities financially. In this context, it suggested that governments:

1. Support the use of technology through policy making in higher education. Encouraging and supporting technology in adapting learning experiences.in this way, it would be possible to encourage equitable access to higher education and improve learning outcomes for all learners. Sustainability of this endeavour might be encouraged by setting up a government programme of support for technology creation and reuse.
2. Raising awareness of key technology. Include the development and sharing case studies of good practices and relevant example of use to support implementation offers. Government can assist higher education stakeholders to understand issues surrounding social media as well how social media are being challenged and reshaped by the rapid digitalisation and online sharing of information and resources.
3. Promote national ICTor connectivity strategies. This support could focus on ensuring provision of connectivity and staff or students access to ICT within higher education systems.
4. Support the sustainable development and sharing of quality learning materials. Key to the sustainable development and use of social media will be supporting higher education institutions, individually and collectively, in their efforts to produce and share high quality educational resources. This could include support for national initiatives to develop local content and regional/global efforts to develop social media repositories and directories, as well as fostering mechanisms to promote quality in social media. There is no single strategy that will work for every context, but a coordinated approach would likely yield the best results.

CONCLUSIONS

With the nature of communication and collaboration, social media can be an important tool for higher education. Social media change the process of knowledge transfer that has been centralized from centered student-teacher to collaborative. Students are expected to be able to independently perform collaboration and collective learning.

The potential of social media can also be used by teachers to do collaborative teaching. Utilizing a variety of social media applications, teachers can incorporate a variety of teaching methods. Not only teach, teachers can also do collaborative research with many colleagues around the world.

If universities want to implement social media technologies, especially in education, planning must be done very carefully. All resources have to be prepared if they want to use social media in education. Most of all, cost is the bottleneck factor of social media in education. For this reason, the university should establish a strategic partnership with the private sector for financing this problem.

In the private sector, the potential market of social media as a means of education are still very large due to the current market is still like to use social media in marketing, interpersonal communication and so forth. Understanding of consumer needs is an important factor as the basis for making planning applications on social media education.

As a regulator, the government should create a policy governing the use of technology as a means of education. Next step is to encourage the use of this technology into a new habit in the community and providing training resources to be able to make use of technology in education. High-quality educational materials are also the key to success because without education materials, social media is something that is empty and meaningless.

In Indonesia, the use of technology in education has been conducted on the initiative of the Ministry of National Education through Jardiknas, especially Edu2000.org and Giga-mmh.org a pioneer and start delivering results. Unfortunately progress is slow due to their low levels of internet speed is still slow and the high cost of internet connections for their users. Surely this is a homework for us together to optimize the use of technology in education for fostering the intellectual life of the nation.

BIBLIOGRAPHY

Vaneeta-marie, D'Andrea and Gosling, David.(2005). Improving Teachingand Learning, A Whole Institution Approach. England: Society for Research into Higher Education & Open University Press. McGraw-Hill Education.

Frias, Esteban Romero, Montano, Jose Luis Arquero. (2010) Exploring The Use Of Social Network Sites On Accounting Education: A Social Constructivist Approach. *www.asepuc.org/banco/25.pdf*

Bonzo, Justin and Parchoma, Gale . (2011). The Paradox of Social Media and Higher Education. http://www.lancs.ac.uk/fss/organisations/netlc/past/nlc2010/abstracts/PDFs/Bonzo.pdf

Conole, Gráinne and Alevizou, Panagiota. (2010). Higher Education in a Web2.0 World. Report Of An Independent Committee Of Inquiry Into The Impact On Higher Education Of
Students' Widespread Use Of Web 2.0 Technologies. Milton Keynes: The Open University

Bradwell, Peter. (2009). The Edgeless University Why Higher Education Must Embrace Technology. London: Demos

Rodriguez . (2011). Social Media Use In Higher Education: Key Areas To Consider For Educators. MERLOT Journal of Online Learning and Teaching. http://jolt.merlot.org/vol7no4/rodriguez_1211.htm

Selwyn, Neil. (2011). Social Media In Higher Education, Vol. 7, No.4, December 2011. Routledge. www.worldoflearning.com

Lon Safko. 2010. Social Media Bible 2nd Edition. Tactics, Tools, And Strategies For Business Success. Hoboken, New Jersey: John Wiley & Sons, Inc.

White, B., Tsang, P., King, Irwin. (2010) Social Media Tools and Platforms in Learning Environments. Berlin: Springer.

Crook, Neil. (2008). Education 2.0?. Designing the web for teaching and learning. A Commentary by the Technology Enhanced Learning phase of theTeaching and Learning Research Programme. http://www.tlrp.org/tel.

Irawati, Dessy. (2006). Understanding the Triple Helix Model from the Perspective of the Developing Country: A Demand or a Challenge for Indonesian Case Study?. Newcastle University, Business School. mpra.ub.uni-muenchen.de/5829

Miron, Dumitru. (2008). Linking The Double Helix Of Learning And Work To The Triple Helix Of University – Industry – Government In The Europe Of Knowledge. Management & Marketing (2008) Vol. 3, No. 4, pp. 3-20. http://www.managementmarketing.ro/pdf/articole/114.pdf

Asia, Digital.(2011). DIGITAL MEDIA ACROSS ASIA. https://wiki.smu.edu.sg/w/digitalmediaasia/index.php

INCREASING FACULTY RESEARCH PRODUCTIVITY VIA A TRIPLE-HELIX MODELED UNIVERSITY OUTREACH PROJECT: EMPIRICAL EVIDENCE FROM THAILAND

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Abstract

This paper presents empirical evidence from Thailand on faculty research productive increased via a triple-helix modeled university outreach project. It is evidenced that faculty research productivity of Thai faculty members could be raised as these faculty staff participate in such collaborative project based on a triple-helix model of government-university-industry relations. The increased productivity is evidenced by the development of research interests of junior and senior staff, the implementation of academic research as a direct contribution to social and economic development and the emerged and sustained linkage of outreach activities participated by the government, the university and the industrial partners. Despite these findings, the paper also discusses another aspect of the findings regarding the research productivity that there is the lack of academia knowledge commercialization, which is widely recognized as desirable quality of academic research produced recently. Given the research findings, this paper therefore discusses the way in which academia taking part in the triple helix relation is able to put in economic, in addition to its academic, value to the knowledge gained.

Keywords: Triple Helix; Research Productivity; Knowledge Commercialization; Univeristy Outreach; Thailand

UNIVERSITY AND THE LOCAL DEVELOPMENT IN GOIÁS – BRAZIL

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Abstract

This paper discusses the relationship between the University, the Government and the local company in an economic development in Goiás, Brazil, in the context of productive restructuring and innovation. The object of study is the University since it is the locus of knowledge production and this is an important resource to the development and to the wealth of a State. This study is justified by the creation of State University of Goiás (UEG) by the local govern to expand access to higher education. This actor possibly performs bureaucratic capacity and empowerment of the State. So, this study aims to investigate the State University of Goiás (UEG) which is located in 42 cities around the state and the theoretical reference discuss the interaction between University, company and Government based on the "Triple Helix" model, which proposes to improve conditions for innovation in a knowledge-based society. The question is what is the University (UEG) interaction with local development, particularly local businesses and how its actions have caused impacts and results in the State of Goiás? For this, it seeks to know the type of structure of the model of entrepreneurial University, which is a process driven internally (from inside out), by cultural and infrastructure changes. The research methodology is qualitative and descriptive which refers to the review of the literature and documentary research of the theoretical content to support the discussion of the object. This is also a case study from UEG and theoretical reference are the evolutionary theories and, in the specific institutionalism approach of triple helix, applied to the study on the role of University in local development. This ongoing research reveals that the role of the University has been transformed by required training, employee training, technological infrastructure which has the challenge of the generation and the transfer of knowledge, innovation and technology through interaction and research for economic actors.

Keywords: university, Government, local development, the triple helix.

ACADEMIA-INDUSTRY INTERACTIONS IN NIGERIA PHARMACEUTICAL INNOVATION SYSTEM

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Abstract
This study examined the types, nature and intensity of academia-industry interactions in Nigeria's pharmaceutical innovation system. Eight (8) top-ranked universities offering Pharmacy as a course of study, 2 Pharmaceutical Research Institutes and 25 pharmaceutical firms were sampled for the study. Interactions are predominantly in the form of knowledge flow and consultancy, staff exchange/fellowship programmes as well as sponsored workshop participations. Intensity of interactions is limited as only 20% of pharmaceutical researchers from Universities and 7% from Research Institutes had strong interactions with Pharmaceutical firms, while only 4 firms have strong interactions with the researchers.

Keywords: Academia; pharmaceutical industry; research and development (R&D); interaction; innovation

LOCAL ECONOMIC DEVELOPMENT AND TRIPLE HELIX : LESSON LEARNED FROM ROLE OF UNIVERSITIES IN HIGHER EDUCATION TOWN OF JATINANGOR, WEST JAVA, INDONESIA

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Abstract
University as one of the Local Economic Decelopment (LED) agents have ample space for local community to formulate a specific form of LED, that is elaborated from development from below (bottom-up) and from above (top down). This article describes the terms of role universities play in LED program, forms and mechanisms of interaction the triple helix in program of LED, as well as the positive impact the university's role in LED that can support regional development planning that is sensitive and responsive to the needs of local communities. This article also describe LED which accommodates the role played by universities in a planned manner in the utilization of assets will create a local initiative that integrates with the location of the university.
This study was exploratory, through participation observation based on a few cases in higher education town. Jatinangor is university town acts as stimulator of regional development, strategic regions, science park area, agglomeration of the universities, as well as the collective action of society (local forums). Triple helix and the LED at Jatinangor are important role in driving local initiatives development through collective action that synergize and integrate the interests of community and region.
This study found that the university plays a role in LED based on social glue among universities, active actor in interaction, and behavior of university leadership institute in support of LED. The findings support the explanation that the success of collaboration depends on cohesivity, leadership, mutual understanding,trust, information, and transparency process. Cohesivity of interaction is based on the recognition and fulfillment needs of the actors (individual interest) and interest of the institution (institutional interest), which led to the social glue among the actors involved as well as among agencies.
Interaction amongs actors are process of social interaction and collective learning that gives rise to collective decision-making process for the sustainability of LED program. These process are helping to solving problems, meeting the needs of the region, and disseminating of innovation. Universities that proactive and responsible participation in the planning process will drive local resources, business development services, local needs and socio-economic problem-solving environment around the campus, so its existence to receive recognition from the government, communities and businesses in sustainable development of region.

Keywords : University; LED; collective-action; triple-helix; regional

E. Higher Education Role in Triple Helix

RELATIONSHIP AMONG SOFT SKILLS, HARD SKILLS AND INNOVATIVENESS OF KNOWLEDGE WORKERS IN INDONESIA

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Abstract
For the last two hundred years, neo-classical economics has recognized only two factors of production: labor and capital. But, nowadays information and knowledge are replacing capital and energy as the primary wealth-creating assets. Technological developments have transformed of wealth-creating work from physically-based to knowledge based. Technology, knowledge as well as innovation are now the key factors of production.
The Organization for Economic Co-Operation and Development (OECD) in 1996 stated that Knowledge is now recognized as the driver of productivity and economic growth, leading to a new focus on the role of information, technology and learning in economic performance. The term "knowledge-based economy" stems from this fuller recognition of the place of knowledge and technology in modern OECD economies. Knowledge economy is economy based on creating, evaluating, and trading knowledge. In a knowledge economy, labor costs become progressively less important and traditional economic concepts such as scarcity of
resources and economies of scale cease to apply.
Creating knowledge relates to education system to create knowledge workers and innovation system which is developing soft skill (workers behavior), as well as Positive Psychological Capital (Luthan et. al, 2007) and hard skill such as ICT literacy. The innovation system, which contributes to innovativeness, in any country consists of institutions, rules, and procedures that affect how it acquires, creates, disseminates, and uses knowledge. Innovation in a developing country concerns not just the domestic development of frontier-based knowledge
(The World bank Institute, 2005).
The objectives of this research are to develop conceptual model which is describe the relationship among soft skill, hard skill, and innovativeness knowledge workers in the context of knowledge economy in Developing Country, Especially in Indonesia. The limitation of the study will be applied is only one company as the object of the research. Multiple Regression Analysis or Structural Equation Modelling (SEM) might be appropriate to be used as a method for this research.

Keywords: Soft Skill, Hard Skill, Knowledge Workers, Innovativeness, Knowledge Economy

1. Introduction
1.1 Background

For the last two hundred years, neo-classical economics has recognised only two factors of production: labour and capital. But, nowadays information and knowledge are replacing capital and energy as the primary wealth-creating assets. Technological developments have transformed of wealth-creating work from physically-based to knowledge based. Technology, knowledge as well as innovation are now the key factors of production.

The Organisation for Economic Co-Operation and Development (OECD) in 1996 stated that Knowledge is now recognised as the driver of productivity and economic growth, leading to a new focus on the role of information, technology and learning in economic performance. The term "knowledge-based economy" stems from this fuller recognition of the place of knowledge and technology in modern OECD economies.
Knowledge Economy is Economy based on creating, evaluating, and trading knowledge. In a knowledge economy, labour costs become progressively less important and traditional economic concepts such as scarcity of resources and economies of scale cease to apply. Creating knowledge relates to education system and innovation system, which is need Skills (both hard and soft skills).

Education is the fundamental enabler of the knowledge economy. Well-educated and skilled people are essential for creating, sharing, disseminating, and using knowledge effectively. The knowledge economy of the twenty-first century demands a set of new competencies, which includes not only ICT skills, but also such soft skills as problem solving, analytical skills, group learning, working in a team-based environment, and effective communication.
So Indonesia is interesting country to be researched in knowledge economy relates to the human capital.

1.2 Research Questions

This Research should answer the questions such as:
1. Are there any relationship among soft skills, hard skills and innovativeness knowledge workers?
2. What policies implication can be made for academic, business or government based on research findings?

1.3 Objectives

The objectives of this research are to develop conceptual model which is describe the relationship among soft skills, hard skills and innovativeness knowledge workers in the context of knowledge economy in Indonesia ad developing country; and to give recommendation to the academic, business and government in Indonesia.

1.4 Original Contribution and Benefit

The original contribution of this research is developing develop conceptual model which is describe the relationship among soft skills, hard skills and innovativeness knowledge workers through empirical findings in relevant industry. In the other hand the benefit of this research,
a. For research community: contribution in the area of human behavior, positive psychological capital, and knowledge economy.
b. For business and government: reference of knowledge in defining strategy and program in human behaviour development and policy in the context of knowledge economy.

2. State of The Art

The innovation system in any country consists of institutions, rules, and procedures that affect how it acquires, creates, disseminates, and uses knowledge. Innovation in a developing country concerns not just the domestic development of frontier-based knowledge. It relates also to the application and use of new and existing knowledge in the local context. Innovation requires a climate favorable to entrepreneurs, one that is free from bureaucratic, regulatory, and other obstacles (The World Bank Institute, 2005).
Soft skills are personal attributes that enhance an individual's interactions and job performance. Unlike hard skills, which are about a person's skills set and ability to perform a certain type of task or activity, soft skills are interpersonal and broadly applicable. There are many researches in soft skills, such as Spencer and Spencer (1993). Referring to positive psychology as one of soft skills which shows human behaviour there is key term, positive psychological capital. Research in positive psychological capital (Psy-Cap) has been developed completing human capital and social capital (Luthans et *al.,* 2004; Luthans and Youssef, 2004). Leadership is important in organizations which are consisting of people who have human capital, social capital and positive psychological capital. There was a research to explore relationship between Psy-Cap (Luthans et *al.,* 2004; Luthans and Youssef, 2004) and authentic leadership (Avolio *et al.,* 2004; Luthans and Avolio, 2003). Psy-Cap defined as "an individual's positive psychological state of development that is characterized by: (1) having confidence (self-efficacy) to take on and put in the necessary effort to succeed at challenging tasks; (2) making a positive attribution (optimism) about succeeding now and in the future; (3) persevering toward goals and, when necessary, redirecting paths to goals (hope) in order to succeed; and (4) when beset by problems and adversity, sustaining and bouncing back and even beyond (resiliency) to attain success" (Luthans, Youssef, & Avolio, 2007 in Larson and Luthans, 2006). There are a significant positive relationship regarding the four individual facets (states of hope, optimism, self efficacy and resiliency) with performance and satisfaction. The composite factor may be a better predictor of performance and satisfaction than the four individual facets (Luthans, Avolio, Avey, dan Norman, 2006).
Tan et. Al (2008) has been assessed the relative efficiency of 12 selected Asia Pacific countries in their development of Knowledge Economy (KE). The performances of the selected countries are evaluated using data envelopment analysis (DEA). The DEA scores indicate that four of the emerging countries (India, Indonesia, Thailand and Mainland China) are relatively inefficient in KE development compared to the other eight which are equally efficient. The main reason for their backwardness is due to the outflow of their human capital to the developed countries. Young (2008) proposed that knowledge economy realize when distinctive knowledge how (know –how) to produce competitive products and services become is vital.

3. Methodology

Workers behavior, knowledge workers and innovativeness was measured using questionnaire. The judgment sampling and stratified random sampling method was used in this research. The company object was chosen from the industries which implement design and innovation to produce the goods or services, here house ware Porcelain Company which produce make to order product.

In the context of human behavior, soft skills are researched based on relevant Spencer and Spencer (1993) model and Pys-Cap (Luthan et. al., 2007; Hendarman and Tjakraatmadja, 2007). In addition to the knowledge economy, various variables will be included (Van Oort, 2009) such as:

1. Knowledge workers hard skills with indicators: ICT literacy and management knowledge
2. Innovativeness with indicators: technical and non-technical innovativeness.

Multiple Regression Analysis was used as a method for this research, using SPSS 13.0 for windows software. Figure 1 show the conceptual model proposed that will be tested.

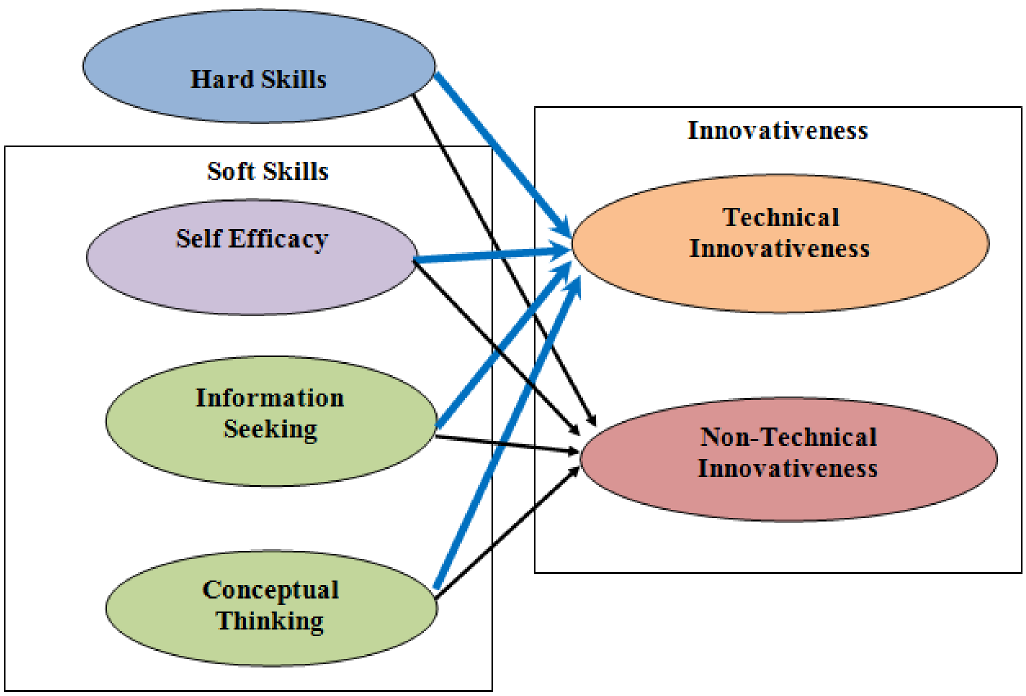

Figure 1 Conceptual Model Proposed

Questionnaires are spread to the employee including staff, middle level management and high level management. The respondent educational level is minimum senior high schools this respondent educational level is chosen as representative for knowledge workers. The valid questionnaires, with 32 respondents, are the full answer variables which are input to SPSS 13.0. Statistically, using multiple regression analysis, the number of data (32 data) is not bad (sufficient) but more data is better. Table 1 until Table 3 describing questionnaire and respondent data.

Table 1 Number of Questionnaires

Questionnaire	Number	Percentage
Spread	60	100%
Collected	45	75%
Valid	32	50.33%

Table 2 Educational Level *

Educational Level		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Senior High School	8	25.0	25.0	25.0
	D1	1	3.1	3.1	28.1
	D3	4	12.5	12.5	40.6
	S1	15	46.9	46.9	87.5
	S2	4	12.5	12.5	100.0
	Total	32	100.0	100.0	

*) S1 (bachelor degree) is the majority respondent with 46.9%, “D” stand for Diploma and “S2” mean master degree level.

Table 3 Job Level*

Job Level		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Top Level management	4	12.5	12.5	12.5
	Middle Level management	16	50.0	50.0	62.5
	Staff	12	37.5	37.5	100.0
	Total	32	100.0	100.0	

***)** Middle level management (supervisor, assistant manager, and division head) and high level management (managers). Middle level is the majority respondent with 50%

4. Findings and Interpretation

These research findings are: 1) all variables are valid for each construct with the factor loading scores is above 0.6 or 0.7; 2) all variables are reliable, with each Cronbah Alpha’s score is above 0.7; 3) only information seeking soft skill that is positively significance influencing technical innovativeness with Sig 0.036, R^2=0.207; and 4) only hard skills that is positively significance influencing non-technical innovativeness with Sig 0.041, R^2=0.187.

Table 1 Construct Validity

Variable	Factor Loading
Hard Skills	
Microsoft office abilities	0.862
Internet abilities	0.865
Management knowledge	0.696
Self Efficacy	
Confidence of finishing the job	0.967
Confidence of getting best result	0.967
Information Seeking Soft Skill	
Degree of Information seeking	1
Conceptual Thinking Soft Skill	

Degree of conceptual thinking	1
Technical Innovativeness	
New product	0.871
Old product improvement	0.900
New service	0.824
Old service improvement	0.887
New product for the market	0.908
New product but not new for the market	0.796
Non-Technical Innovativeness	
Cooperation with other institution	0.909
Marketing system improvement	0.909

Table 2 Reliability

Factor	Cronbach's Alpha
Hard Skills	0.932
Self Efficacy	0.930
Technical Innovativeness	0.932
Non-Technical Innovativeness	0.788

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.432[a]	.187	.066	1.24434

a. Predictors: (Constant), SoftSkillConceptualThinking, SoftSkillInformationSeeking, PsyCapSE, HardSkills

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.253	2.175		1.036	.309
	HardSkills	-.082	.248	-.063	-.330	.744
	PsyCapSE	-.126	.371	-.062	-.341	.736
	SoftSkillInformation Seeking	.430	.200	.397	2.149	.041
	SoftSkillConceptual Thinking	.138	.246	.105	.562	.579

a. Dependent Variable: TechnicalInnovativeness

Figure 2 Technical Innovativeness (Dependent Variable) Multiple Regression Model Summary and Independent Variable Significance

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.455[a]	.207	.089	1.07205

a. Predictors: (Constant), SoftSkillConceptualThinking, SoftSkillInformationSeeking, PsyCapSE, HardSkills

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-2.442	1.874		-1.303	.204
	HardSkills	.471	.214	.413	2.202	.036
	PsyCapSE	.461	.319	.260	1.443	.161
	SoftSkillInformation Seeking	.022	.172	.023	.127	.900
	SoftSkillConceptual Thinking	.160	.212	.140	.756	.456

a. Dependent Variable: NonTechnicalInnovativeness

Figure 3 Non-Technical Innovativeness (Dependent Variable) Multiple Regression Model Summary and Independent Variable Significance

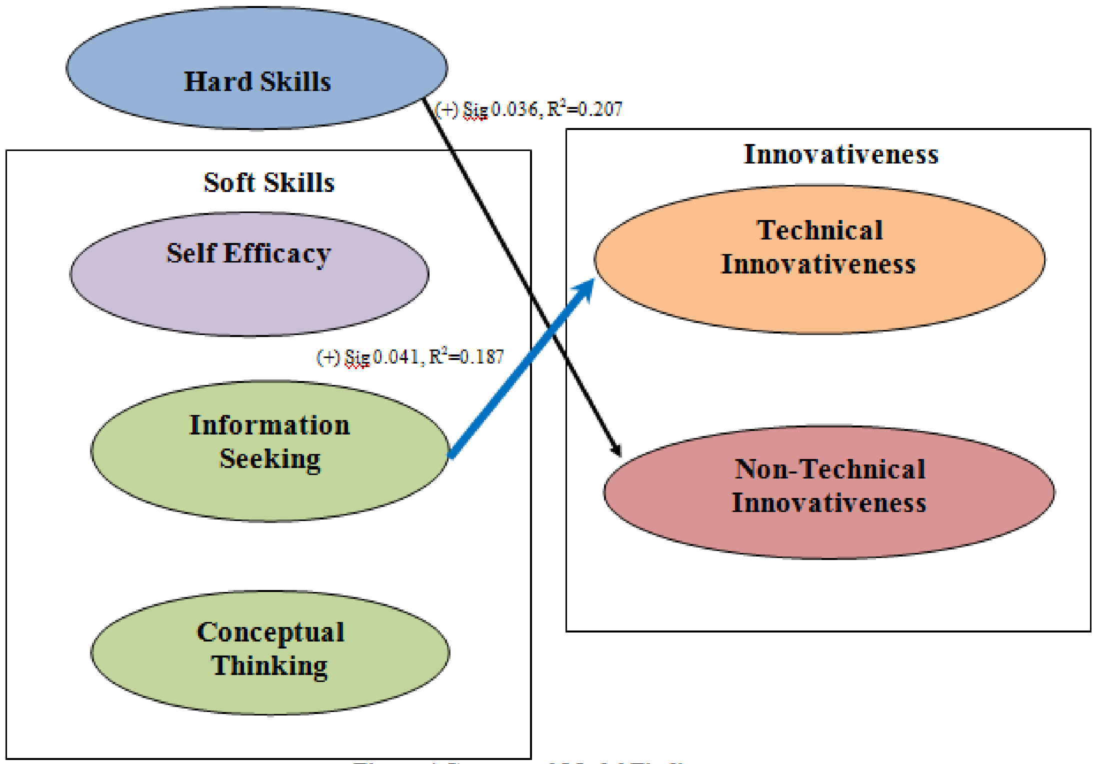

Figure 4 Conceptual Model Findings

5. Conclusions

In KE era to have innovative employee is important, innovative employee who have technical innovativeness is need soft skills. In this research **information seeking soft skill** is found positively significant influencing **technical innovativeness** which is needed to create new product or services. In the other hand, **hard skill**, which is consist of the ability to use Microsoft Office software, internet and management knowledge, is found positively significant influencing **non-technical innovativeness**, which consist of the ability to cooperate with other institution and the ability to improve marketing or strategy**.**

6. Policy Implications

For academic purposes, this research gives richness to the people and knowledge management area. In KE era, especially in Indonesia, information seeking soft skill is important to be delivered in educational system not only in higher educational level but also in the lower level education. Furthermore, hard skill which is consist of the ability to use Microsoft Office software, internet and management knowledge supposed to be deliver start from elementary school.

For Business purposes, company need to develop its employee skills by deliver information seeking soft skill and hard skills, minimum the skill to operate the personal computer and internet, last but not least is to improve the management and business knowledge.

For Government, specific policy to support information seeking soft skill and hard skill to increase the ability to use or operate personal computer and internet is important in order to increase employee innovativeness.

7. Directions for further research

Some directions for further research are: exploration other soft skills and hard skills variables, research in creative industries, more samples and more companies number, and data processing using Structural Equation Modelling or Partial Least Square can be possible.

References

Drucker. 1999. http://www.knowledgeworkerperformance.com/Peter-Drucker-Knowledge-Worker Productivity.aspx

Hendarman, A. Fajar, Tjakraatmadja, Jann Hidajat. 2007. *Relationship Among Employees' Phsycologycal Capital, Servant Leadership, and Employees' Performance*. International Colloquium on Business and Management, Bangkok, Thailand.

Indonesia Ministry of Domestic Affair. 2009. http://www.depdagri.go.id/basi data/2010/01/28/daftar-provinsi.

Jensen, Susan M., Luthans, Fred. 2006. *"Relationship between Entrepreneurs' Positive psychological capital and Their Authentic Leadership"*. Journal of Managerial Issues Vol. XVIII Number 2 summer 2006: 254-273.

Larson, M., Luthans, Fred. 2006. *Potential Added Value of Positive psychological capital in Predicting Work Attitudes*. Journal of Leadership & Organizational Studies. Flint: 2006.Vol.13, Iss. 1; pg. 45.

Luthans, Fred; Avolio, Bruce J.; Avey, James B.; Norman, Steven M. 2006. *Positive Positive psychological capital: Measurment and Relationship with Performance and Satisfaction*. Gallup Leadership Institute-Department of Management, University of Nebraska-Lincoln; Department of Management, Central Washington University; Department of Management,Mesa State College

OECD. 1996. http://www.oecd.org/dataoecd/51/8/1913021.pdf.

Tan, H. B., Hooy, C. W., Islam, S. M. N., & Manzoni, A. 2008. *Relative efficiency measures for the knowledge economies in the asia pacific region*. Journal of Modeling in Management, 3(2), 111-111-124. doi:10.1108/17465660810890108

The World Bank Institute. 2005. http://info.worldbank.org/etools/docs/library/145261/India_KE_Overview.pdf.

Wren, Daniel A. 2005. *The History of Management Thought.* John Wiley & Sons. United States of America.

Young, T. 2008. *Defining and building the "knowledge economy"*. Knowledge Management Review, 11(2), 8-8-9. Retrieved from http://search.proquest.com/docview/217472634?accountid=31562

Van Oort, F.,G., Oud, J. H., L., & Raspe, O. 2009. *The urban knowledge economy and employment growth: A spatial structural equation modeling approach*. The Annals of Regional Science, 43(4), 859-859-877. doi:10.1007/s00168-009-0299-2

A STUDY ON THE CAPITAL SCIENCE AND TECHNOLOGY RESOURCE PLATFORM IN BEIJING

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Abstract
The distribution of technological resource in China has been facing a series of problems including scattered resources, unnecessary duplication, insufficient management, etc. As one of the main innovative centers of China, Beijing accounts for about one-third of the whole nation's science and technology infrastructure resources. Howver, even in Beijing a rather uneven distribution of these resources still exists, with universities and large researchinstitutes being the key owners, while SMEs, which have strong needs for these resources, could hardly reach them.
In order to effectively promote the sharing of these valuable resources, the Beijing Science and Technology Committee started the reformation of the Capital Science and Technology Resource Platform (CSTRP) since 2009. The CSTRP introduces market-oriented professional service companies as the third party into the cooperation of the supplier and end user of the technological resources, and under the operational guidance and performance evaluation of the government, a win-win mechanism is created without dramatically changing the existing institutional framework or disturbing the profound interest of all these different parties.
From the analysis of this paper, we can see that up till late 2011, the CSTRP has been proved innovative and successful: Since 2009 more than 7000 SMEs have been enjoying the services through the CSTRP, and a total contract volume of 1.3 billion RMB had been reached. The CSTRP closely and organically integrates the three main parties of the development and use of technological innovations: the universities (main suppliers), the SMEs (main users as well as sponsors), and the government (main coordinator). Within the CSTRP, the roles of the three upper mentioned parties complement each other and intertwine to form an organic triple helix model, serving better than the previous cooperation method in matching the demand and supply of technological innovation and creating a considerable economic value.
In this study we'll analyze the development of the CSTRP by applying the Triple Helix Theory, together with other related theories, and discuss to what extent the CSTRP model could be applied in other settings.

Keywords: Science and Technology Resource, Platform. Beijing

Introduction

Beijing is the political, economic, and technology center of China, and occupies about one-third of the whole nation's science and technology (S&T) infrastructure resources. Up to 2007, Beijing had 68 State Key Laboratories, 47 National Engineering Technology Research Centers, 37 National Engineering Research Centers, 23 National Engineering Laboratories, and 34 National Enterprise Technology Centers, representing 34.2%, 31.5%, 30.1%, 55% and 6% of these S&T infrastructures in the country, respectively. In 2008, the number of people conducting technological activities in Beijing reached 0.45 million, and 0.36 million are scientists and engineers, about 10.5% of the whole nation's scientists and engineers (Table 1.1). In the same year, Beijing's R&D investment intensity (R&D expenditure/GDP) reached 5.25%, the highest among the six provinces/cities[1] that had a R&D expenditure of more than 30 billion RMB Yuan (Table 1.2).
Meanwhile, Beijing is also the technology development leader in China. Up to 2007, scientific research institutions in Beijing had undertaken 39.4%, 23.2%, 28.1%, separately, of the projects sponsored by the three core National S&T Programs (the 973 Program, the 863 Program, and the National Key Technology R&D Program). Between 2001 and 2006, 40.3% of the first prize awards of the National Prize for Progress in Science and Technology and 27% of the second prize awards of the National Prize for Progress in Science and Technology were obtained by organizations in Beijing.

[1] The six provinces/cities are: Beijing, Shanghai, Jiangsu, Zhejiang, Guangdong and Shandong.

Table 1.1 Beijing's technology index, 2008[1]

Index	Beijing	China	Beijing/China
People conducting technological activities (million)	0.45	4.97	9.1%
Scientists and engineers (million)	0.36	3.44	10.5%
R&D expenditure (billion RMB)	55.04	461.60	11.9%
R&D expenditure/GDP (%)	5.3	1.5	-
Technology market turnover (billion RMB)	102.72	266.5	38.5%
All Patent granted	17747	411982	4.3%
Innovation patent granted	6478	93706	6.9%

Table 1.2 Cross province/city comparison of technology index, 2008[2]

Index	Beijing	Shanghai	Jiangsu	Zhejiang	Guangdong	Shandong
R&D expenditure (billion RMB)	55.04	35.54	58.09	34.46	50.26	43.37
R&D expenditure/GDP (%)	5.3	2.6	1.9	1.6	1.4	1.4
Proportion of the city's public expenditure	5.7%	4.6%	2.8%	3.9%	3.5%	2.1%
Technology market turnover (billion RMB)	102.72	38.62	9.40	5.89	20.16	6.60

Although Beijing as a city has rich S&T resources, these resources are not evenly distributed but are mainly owned by and located in universities and large research institutes. For example, in 2008, among the 6709 sets of large equipment (the value of each is more than 100 thousand RMB), 37% were owned by large research institutes and 42% were owned by universities. In 2007 investment in S&T resources reached 49.5 billion RMB Yuan in Beijing. Among the investment, large research institutes got 34.5 billion and universities got 6.3 billion. Large research institutes and universities accounted for 82.4% of the total investment. In addition, from 2004 to 2008, universities and large research institutes in Beijing had been continuously purchasing more equipment, and the investment was more than that of the enterprises (Fig. 1.3).

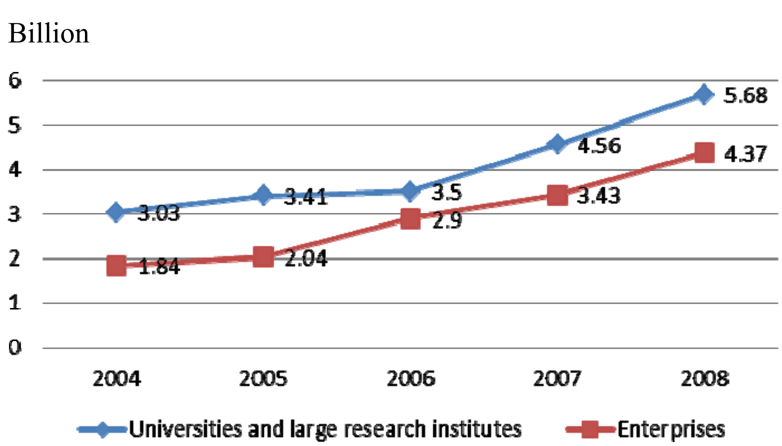

Fig. 1.3 Beijing's R&D expenditure on equipment purchasing, 2004-2008[3]

To some extent, the uneven distribution of S&T resources is a misallocation and inefficient use of these resources. On one hand, universities and large research institutes are not motivated to buy and use their S&T resources such as equipment effectively, leading to a lot of problems such as scattered resources, unnecessary duplication and ineffective management and utilization. On the other hand, enterprises, including SMEs, are supposed to be the key driving force for innovation. However, these firms do not have enough S&T resources by themselves. They are hardly able to use S&T resources controlled by universities and large research institutes. This suggests that promoting the sharing of S&T resources between universities and large research institutes and firms could be beneficial to both the S&T resources owners and users.

In order to effectively promote the sharing of S&T resources, the Beijing Science and Technology Committee initiated the development of the Capital Science and Technology Resource Platform (CSTRP) program in 2009. This initiation has made good progress: Since 2009 more than 7000 SMEs have been enjoying the services through CSTRP, and a total contract volume of 1.3 billion RMB for the sharing of S&T resources had been reached. The CSTRP has played an active role in integrating the three main parties of sharing of S&T resources: the universities and research institutes (the main suppliers of S&T resources), the SMEs (the main users as well as sponsors), and the government (the main coordinator).

Theoretical background

We mainly relied on two streams of literature to guide our research. The first stream of literature is studies on triple helix. Henry Etzkowitz and Loet Leydesdorff introduced the triple helix method to the analysis of the relationship and interaction among university, industry and government in an innovation process. Different from the linear innovation model that equals innovation to the application of scientific theories and the National System of Innovation model that regards firm as the core of the innovation system, the triple helix theory states that regional or industrial innovation relies on the trilateral interaction among university, industry and government. None of the three parties occupies the leading role. They're all organizers and participants of the innovation activities. They interact with each other, rely on each other and push further the innovation process together[4].

According to Etzkowitz and Leydesdorff, a minimum of three forms of triple helix model were identified [5], and the third form of triple helix model, which is shown in Fig. 2.1, is becoming widely accepted and pursued by many nations. Although the triple helix model distinguishes its three components (university, industry and government), it also emphasizes that their borders are fading out and all three parties, besides fulfilling their own functions, are undertaking certain roles of the other parties, and as a result many hybrid organizations emerge at the interfaces, such as derivate firms set-up by university students and government-led industry innovation unions.

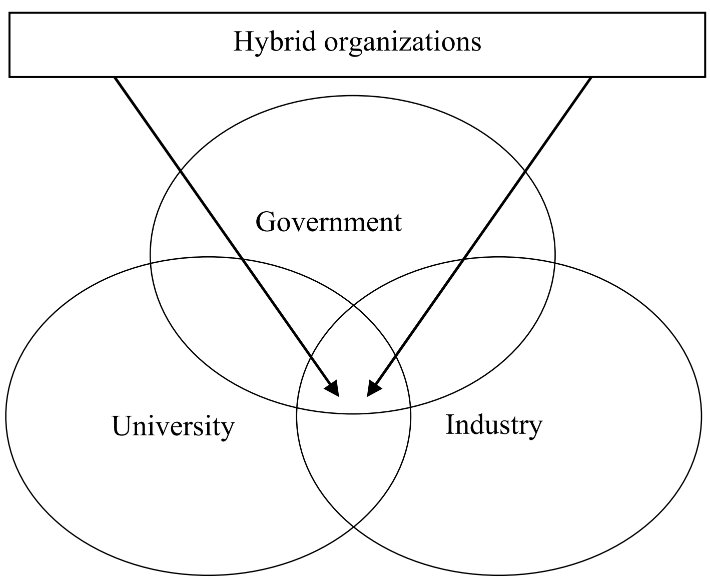

Fig. 2.1 Triple helix III

The triple helix mechanism requires high level of synchronicity as well as compatibility between the three parties for effective operation: if one or two helices develop slowly or couldn't match with each other, the synergy of innovation between the production sector, the administration sector and the research sector could not be achieved. Therefore, the key concept of the triple helix theory is that university, industry and government are three helices of an evolving network based on communication as its core [6]: only by virtuous interaction among the three parties in the process of generating, spreading and applying knowledge can the whole network be effectively improved.

The second stream of literature is studies on innovation networks. In the early concept of innovation network, K. Imai and Y. Baba defined it to be a basic system protocol for systematic innovation, and the main connection mechanism within the network structure is the innovation cooperation relationship among the enterprises [7]. Freeman further divided the innovation network into different types including joint ventures and research companies, cooperative R&D agreement, technology exchange agreement, direct investment driven by technological factors, licensing agreement, joint research sponsored by the government, etc. [8].

Innovation network includes different nodes. Formal and fixed relations between two nodes are called *Strong Ties*, and informal or implicit relations are called *Weak Ties* [9]. Information (including marketing information and technology information) exchanges often rely on the strong ties since they are more adhesive and more effective in complicated information exchanges, while weak ties are proved to have further extensions and are apt to include information with heterogeneity. CSTRP is essentially an innovation network for the purpose of stimulating the sharing of S&T resources and supporting technological innovations of firms including SMEs.

Methodology and data

This paper is based on a research project sponsored by the Beijing Science and Technology Committee. In China, the uneven distribution of S&T resources is a common problem in all provinces and major cities. Beijing has become a leading in addressing this challenge. In order to further improving the effectiveness of sharing S&T resources, the Beijing Science and Technology Committee asked us to help study their practices in the past few years and give suggestions. Because using CSTRP to support the sharing of S&T resources is a new phenomenon, we used a case study method and tried to develop some insights into this phenomenon [10]. Because this research is requested and supported by the Beijing Science and Technology Committee, we were able to collect data needed to analyze the key factors affecting the evolution of CSTRP in Beijing.

Key findings

Our study suggests that CSTRP has been able to make good progress in helping share S&T resources for four reasons: creating consensus among all participants; creating a win-win situation for all participants; introducing the intermediary service sector (for example, market-oriented professional service organizations); and balancing the supply side and the demand side. In the following we analyze these three factors. We also use a specific example to illustrate these factors.

First, creating consensus among all participants is the precondition for effective sharing of S&T resources. Before the official initiation of CSTRP, from the second half of 2008 the Beijing Science and Technology Committee visited representative universities, research institutes and firms such as the Tsinghua University, the Beijing University, the Chinese Academy of Sciences, etc.. More than 200 times of communications were conducted with the leaders of these organizations. A consensus was developed based on these visits and communications: The sharing of S&T resources could benefit all participants, although there would be a lot of challenges in the process of sharing.

Second, creating a win-win situation for all the participants is the basis for sharing S&T resources. Fig. 3.1 illustrates the win-win situation among all participants: the government, S&T resource owners, intermediary service sector and the demand side of S&T resources. Specifically, under CSTRP, the demand side of S&T resources (for example, SMEs) could enjoy R&D services with guaranteed quality provided by the S&T resource owners; the S&T resource owners could be aware of the latest market demand and find more sources of research topic through direct and indirect interaction with the demand side; and the intermediary service sector (for example, professional service organizations) could serve a bigger market and make more money. The win-win design in CSTRP implies that those who provide services are the ones who benefit, and that those who provide more services are the ones who benefit more.

When CSTRP was first initiated, the Beijing Science and Technology Committee provided some financial support (58 million RMB). For example, a major function of the government funds is to subsidize the intermediary service sector in order for them to play the bridging role more effectively. However, it is expected that CSTRP would finally be able to support themselves financially from the money they make in promoting the sharing of S&T resource. Comparing with other provinces' practices, which are mainly focusing on equipment purchasing and service subsidy, the CSTRP approach seems to have created a new approach and more effective approach of using government funds.

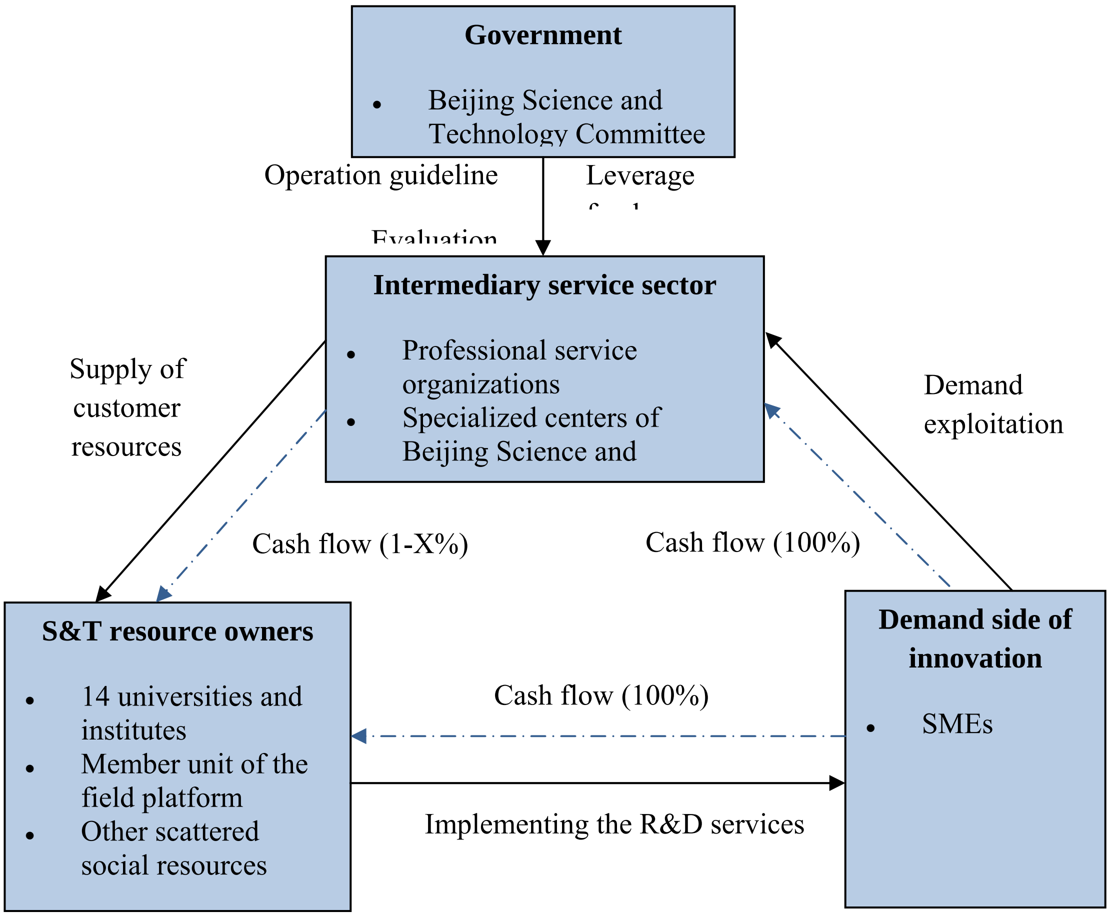

Fig. 3.1 Design and operation of CSTRP

Third, the introducing of the intermediary service sector (for example, market-oriented professional service organizations) is of crucial importance. Specifically, these professional service organizations could play a bridging role between the owners and users of S&T resources. On one hand, these professional service organizations could take initiatives to combine and classify the available resources in order to stimulate the mobilization of the S&T resources and build trust from the owners of the resources through effective marketing activities. On the other hand, the professional service organizations could have better understandings than universities and research institutes about the actual need of the SMEs since they already have solid business connections with these firms.

Fourth, balancing the supply side and the demand side of S&T resources offers important guidance. For a long time, the Beijing S&T policies have been focusing on improving and strengthening the supply side of the S&T resources. This is also true for other cities and provinces in China. The limited attention paid to the demand side has exacerbated the mismatch of S&T resources. CSTRP understands the importance of enhancing the supply of and urging universities and large research institutes to open up their S&T resources. At the same time, CSTRP emphasizes the importance of meeting the needs of the SMEs, and on the role played by the demand side role in the process of sharing S&T resources. Supported by 10 specialized centers such as the Biology Center, the Software Center, and the New Material Center, which are affiliated with the Beijing Science and Technology Committee, CSTRP has built up CSTRP working stations to bridge owners of S&T resources and SEMs with specific demands for technological services.

Discussion and conclusion

The triple helix theory suggests that it is essential to form virtuous interaction among university, industry and government during the generation and application of new knowledge. With the realization of close interaction among the three helices, CSTRP fits perfectly with the essence of the triple helix theory. CSTRP is the result of the joint efforts of university, industry and government, and it is also a platform for the three parties to interact with each other and create mutual benefit. During the development of CSTRP, the Beijing Science and Technology Committee facilitated the combination of S&T resources held by universities and large research institutes, technological talents and S&T achievements into the open system of CSTRP, so that the demand of SMEs for scientific researches and tests could be better met.
In the development and evolution of CSTRP, the participants are also transforming themselves. For example, research universities are playing a new role in innovation: they are more than institutes responsible for education and research; instead, they share the functionality of social service as well. In some universities[2] new policies have been introduced. For example, S&T services could be counted as research workload and be linked with professional promotion, a major deviation from the traditional evaluation system in universities. The Beijing Science and Technology Committee has made impressive progress in transforming itself from a project-based government agency to a innovation system development oriented organization, and from a management-oriented government to a service-oriented government.
The CSTRP experience also illustrates the guiding role of theories about innovation networks. First, to some extent, what the Beijing Science and Technology Committee has been doing is to make innovation networks more effective (Fig. 4.2). Through the development of CSTRP, connections between various kinds of nodes, for example, government agencies (the Beijing Science and Technology Committee), specialized centers, industry alliance, professional service organizations, universities and large research institutes, and firms such as SMEs, in the innovation network, have been created or strengthened.

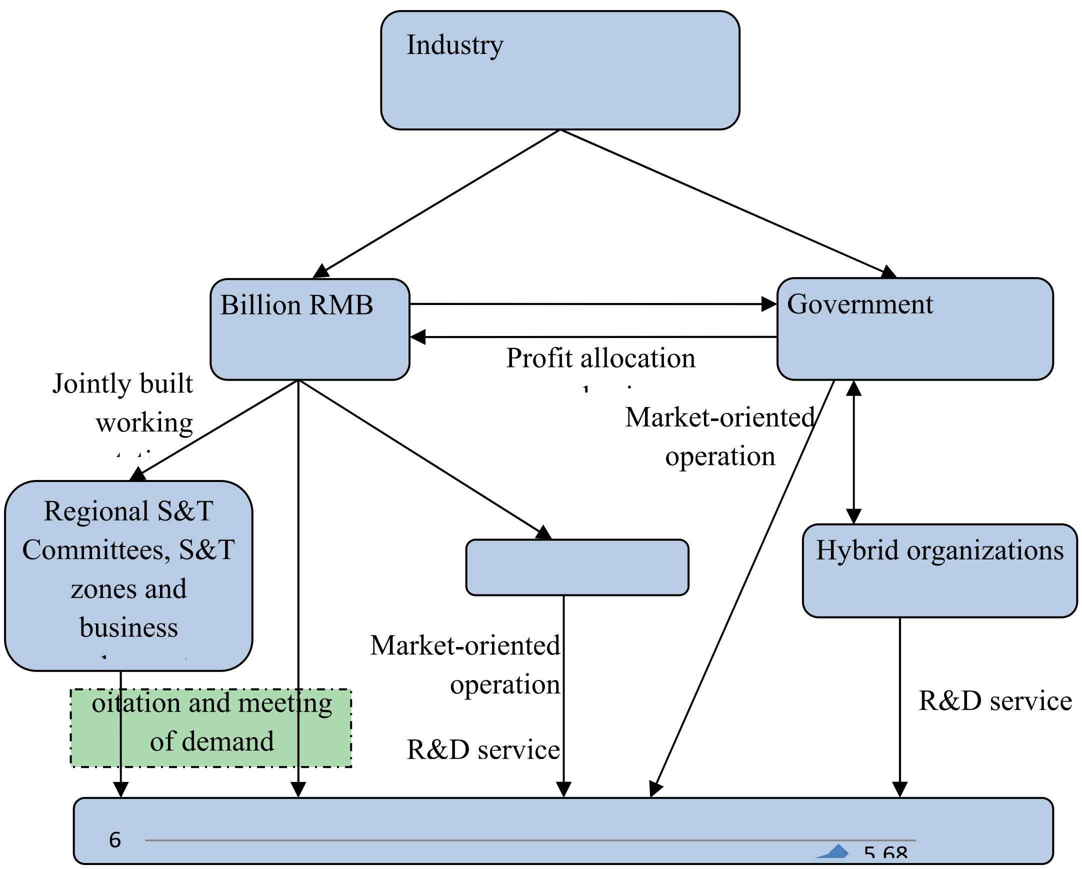

Fig. 4.2 CSTRP operating network

[2] One of the representatives is the North China University of Technology (NCUT).

Second, different types of ties are helping with improving the effectiveness of the innovation networks. On one hand, lots of strong ties based on working mechanism, profit allocation mechanism and evaluation mechanism have been formed between different nodes of the innovation network within CSTRP. For instance, links between the professional service organizations and the S&T resource owners were all built on the ground of contracts. This is also true for links between the professional service organizations and the specialized centers, and links between the specialized centers and the working stations. On the other hand, the Beijing Science and Technology Committee has been actively helping the development of weak ties within the innovation network. A club with CSTRP as the organizer and the platforms and their member units as participants was established in 2010, and it holds regular activities to facilitate the sharing of S&T resource sharing mechanism building experience, service experience and demand information through informal communication.
The findings of this study have important implications. For example, the formation of an effective innovation network might not be a natural process, and the government could play an important role in facilitating the formation of this kind of networks. Specifically, it could create lots of strong ties, which could then lead to weak ties. Theoretically, the findings of this study seem to suggest that the triple helix model and the network theory could be combined to explain the formation and improvement of innovation networks.

References:
[1] Beijing Statistical Year Book, 2008; China Statistical Year Book, 2008.
[2] China Major Technology Index Database, http://www.sts.org.cn/.
[3] Beijing Statistical Year Book, 2005-2009.
[4] [5] Etzkowitz, H. and Leydesdorff, L. (2000) The dynamics of innovation: from National Systems and “Mode 2” to a Triple Helix of university-industry-government relations. Research Policy, 29(2), 109-123.
[6] Leydesdorff, L. and Etzkowitz, H. (1998) The triple helix as a model for innovation studies, *Science and public policy* 25 (3), 195-203
[7] Baba, Y. and Imai, K. (1993), ‘A Network View of Innovation and Entrepreneurship: The Case of the Evolution of VCR Systems’, *International Science Journal*, 45, 23 – 34.
[8] Freeman. C. (1991) Networks of innovators: A synthesis of research issues. *Research policy*, 20, 499–514.
[9] Fagerberg, J., Mowery, D.C., and Nelson, R.R. (Eds.) (2006). The Oxford Handbook of Innovation. Oxford University Press.
[10] Glaser, B.G. and Strauss, A.L. (1967). *The discovery of grounded theory.* NY: The Aldine Publishing Company.

EMPOWERING A STATE'S DEVELOPMENT OF A KNOWLEDGE SOCIETY: A RETROSPECTIVE ASSESSMENT OF THE KARNATAKA KNOWLEDGE COMMISSION

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Abstract
Karnataka is a large state in South India with an area of about 200,000 square kilometres and a population of about 53 million. It has a long and rich cultural, social, and economic history, a diverse population, a variety of natural resources, a very strong industrial and technological base, and a good primary, secondary and tertiary education infrastructure. It constituted the Karnataka Knowledge Commission (KKC) to mobilize efforts for its transformation into a knowledge society. The initial tenure of KKC was three years; it has now been renewed. The paper is a retrospective assessment of the commission based on the official reports and reviews at the end of its initial tenure based on an ontological framework with the triple helix model at its core

Keywords: Knowledge Commission; Knowledge Society; Knowledge for Development; Ontological Framework

1. Introduction

The ontological framework proposed by Ramaprasad & Sridhar (2011) is composed of three principal axes: (a) Leading, (b) Triple Helix Partnerships, and (c) Outcomes. The outcomes are defined by two components: (a) Functions and (b) Development (type). Thus the outcomes of a triple helix partnership could be ‘knowledge generation for education development’, ‘knowledge application for environmental development’, or a subset of the many other possible combinations. The taxonomies of Functions and Development can be modified to generate more or less combinations which fit a context. The Commission’s role could be in Leading the introduction, enhancement, regulation, etc. of these triple helix partnerships.

Fig. 1. Triple Helix Ontological Framework

At the end of its first three-year tenure, the Commission has commissioned and compiled a number of comprehensive reports and documents about its functions, actions, and outcomes. These include:

I. Research Study Reports:

		Triple Helix Partnerships						Outcomes			
Leading		**Sector 1**		**Sector 2**		**Relationships**		**Functions**		**Development**	
Introducing	[+]	Education sector	[x]	Education sector	[+]	Independence	[for knowledge]	Conservation	[for]	Artistic	[development in a knowledge society]
Enhancing		School Education		School Education		Interaction		Discovery		Cultural	
Facilitating		Vocational Education		Vocational Education		Cooperation		Rediscovery		Economic	
Regulating		Higher Education		Higher Education		Collaboration		Generation		Educational	
Inhibiting		Libraries		Libraries		Symbiosis		Regeneration		Environmental	
Eliminating		Industry sector		Industry sector				Exchange		Health Care/Well Being	
		Private		Private				Transfer		Historical	
		Public		Public				Dissemination		Rural	
		Government sector		Government sector				Application		Scientific	
		Central		Central						Social	
		State		State						Urban	
		Local		Local							

1. A Study on Building Knowledge Society in Karnataka
2. A Study on Aspirations, Expectations and Suggestions of Youth of Karnataka
3. Finances of Universities: A Study of Universities of Karnataka
4. Pre-Service Elementary Teacher Education in Karnataka: A Status Study
5. Developing a Model for Samudaya Jnana Kendras (Community Knowledge Centres)
6. A Study on Gross Enrolment Ratio of Higher Education in Karnataka

II. Research Studies – Executive Summary
III. Jnana Pallava-A Term End Report (2008-2011)
IV. Stakeholders Consultation Report-Higher Education
V. List of Recommendations
VI. Minutes of KKC and other Meetings
VII. Status Report on Recommendations
VIII. KJA Quarterly Reports
IX. KJA Monthly Reports
X. Press Clippings
XI. List of Meetings and Events
XII. Public Affairs Centre's Stakeholders Audit Report
XIII. Note on Arivu Project
XIV. Arivu-Project Process Document (Kannada)
XV. SAHAYOG-Project Process Document
XVI. http://www.jnanaayoga.in/html/media/news_clippings.html (Press Clippings)

The paper presents an in-depth assessment of the Commission using the lens of the Triple Helix ontological framework. We will map the ten projects to-date to the ontological framework to highlight the 'hot' and 'cold' spots in the implementation. The analysis will provide feedback to the commission on the strengths and weaknesses of the first phase. The insights obtained from the analysis will also help the Commission modify its strategy in its next phase. The lessons learned from the Commission will also help other similar efforts in developing (and developed) countries to conceptualize and implement triple helix models. Last, but not the least, the analysis will also refine the ontological framework for future application.

2. Method

We analyzed the ten projects that are underway at the Karnataka Knowledge Commission. The two authors collaboratively developed a brief description of the ten projects which have been launched from the documents listed earlier and their personal knowledge. Projects still at the idea stage or which had not been launched were not included in the analysis. They, then, mapped each launched project to the Triple Helix Ontological Framework – both the authors jointly agreed on each mapping. The ten project descriptions are given below; the individual maps are available from the authors. The summary map was derived by aggregating the ten individual maps.

3. Result

3.1 ARIVU: Open libraries in Government schools with audio-visual materials

Arivu is a project to make libraries in Government high schools effective and functional with appropriate books and audio visual materials to help students and teachers. An expert committee to select books and other materials for helping develop libraries in government high schools was constituted. A manual on Open Library was prepared to carry forward the concept among the targeted group. A pilot project was carried out in 225 Government high schools of the state coming under the Department of Primary and Secondary Education. The books and CDs were identified by the expert committee and distributed by Commission. Racks needed for storing them were also provided by Commission. Teacher- librarians were imparted training on open library system through workshops in Bangalore and Dharwad. Mentoring of these School libraries were also undertaken to encourage them. Rashtreeya Madhyamika Shiksha Abhiyaan (RMSA), a centrally sponsored scheme of Government of India, has taken over this project during 2011-2012 in 500 Government high schools with the help of a resource team of Library and Information Science (LIS) professionals and NGOs.

The project thus has introduced three sets of partnerships: (a) between state government agencies, (b) the state government and the library professionals, and (c) the state government and non-governmental organizations, especially focusing on libraries in school education. These partnerships are based on interaction and co-operation for knowledge dissemination for education development.

3.2 DAKSHA: Development of Educational Leadership

This project involves conducting teacher empowerment training for 3000 assistant professors of Government colleges in 75 batches in 6 regions in a residential mode. These training programs are intended to empower the teachers in pedagogy, ICT, spoken English and life skills. Regional mentors were identified for the trainee teachers. The mentors frequently interacted with the trainees and feedback was collected. This training was first of its kind in Karnataka.

3.3 Dravya Kosha- Regional Pharmacopeias

Project DravyaKosha aims at developing regional pharmacopeias in all districts of the state for conservation, cultivation and sustainable utilization of medicinal plants that can be put to community use, strengthen the community, and help the folk healer associations. These pharmacopeias can also be used in educational institutions for future research and development. Karnataka Jnana Aayoga in its proposal to the project DravyaKosha has outlined the following objectives: to come out with data based information of folk Vaidyas, identify experts in the health field, train the ASHA workers and NGO's, form and strengthen folk practices at different levels (Taluks, Districts and State) and compilation of all information. It also aims at linking Government organizations, non-Government organizations, folk practitioners and private practitioners in this endeavor.

The project plan includes identifying and establishing region-wise plant source database, conduct home remedy programs in urban and rural area, streamline AYUSH, set up traditional health care mission, train di erent stream of health practitioners, students and general public.

The project was, initiated inTumkur and Shimoga districts, implemented through the Department of AYUSH, Government of Karnataka, with the co-operation of Government Ayurvedic Medical College (GAMC), Bangalore and few NGO's. A Project Advisory Committee was constituted under the chairmanship of the Secretary, Health and Family welfare Department to review the project. The project has completed the survey which was published subsequently.

3.4 Innovative Universities

Karnataka has designated two of its oldest universities as Innovative Universities. The objectives of the Innovative University are: (1) to further the cause of higher learning in the State in the current competitive environment; (2) to disseminate and advance knowledge by providing instructional and research facilities in such branches of learning as it may deem fit and by the example of its corporate life, and in particular, to make special provisions for integrated courses in humanities and sciences in the educational programs of the University and to make appropriate measures for promoting interdisciplinary studies and research in the University. (3) to provide an innovative system of University level education, flexible and open, in regard to methods and places of learning, combination of courses, eligibility for enrollment, age of entry, conduct of examination and operation of programs with a view to promote access and equity in higher learning and to encourage excellence in the new fields of knowledge; (4) to provide an equal emphasis on both academic and application oriented learning besides decentralization and separation of the academic and administrative functions; and (5) to promote national integration and the integrated development of human personality through its policies and programs. Some of the salient, innovative features of the proposed Innovative University Bill 2011 are: (a) minimum role for Governor and Education Minister; (b) the appointment of a President of the University by a collegium consisting of Chief Minister, Leader of Opposition, Speaker, Higher Education Minister and Chief Justice of High Court; (c) the appointment of Vice-Chancellor by the President; and (d) co-existence of two systems-namely Unitary and affiliating systems within the same university. Such a university structure is being created for the first time in India; no other state or Central University has these features. It will be a pioneering step in India's Higher Education which can send positive signals about Karnataka in India and about India in the world.

3.5 Jnana Fellowship

The Jnana Fellowship was launched in response to a Karnataka Jnana Aayoga's recommendation to increase meaningful and sustained interface between public system and citizens. The objectives of the fellowship are:

To collaborate with young minds in addressing current critical issues;
To bring in fresh and innovative thinking into the existing system of Government;
To increase interface between public system and citizens; and
To facilitate and add vigor to the efforts carried out by various Government departments.

Jnana fellows would be professional and young individuals who would want to contribute their time and talent to bring about excellence and quality in the public systems. There was a very positive response from the departments who responded with key areas in their departments where the Jnana fellows would contribute.

3,300 young minds responded to Jnana Fellowship call, some of whom were from outside India also. Through a rigorous process, 50 applicants were shortlisted for interview. A panel consisting of former civil servants, representatives of government departments, educationists and industry as members selected 24 Jnana Fellows. Of these 18 Fellows formally joined the Departments on November 8, 2011. Currently, they have undertaken specific and operational projects in eight Departments – Health and Family Welfare, Higher Education, Horticulture, Personnel Administration and Reforms (Election), Planning, Programme Monitoring and Statistics, Primary and Secondary Education, Women and Child Development and Youth Services and Sports.

3.6 Kanaja – A Storehouse of Knowledge

One of the flagship accomplishments of the KJA is the launch of Kannada Knowledge Portal on the lines of Wikipedia – **www.kanaja.in**. Kanaja, in Kannada, refers to the traditional storage space for food grains. The portal is an online repository for all knowledge and information in Kannada. The portal was launched on 5th December, 2009. It compiles and edits all the information on anything and everything in Kannada and disseminates it among all sections including vulnerable sections of society. This will enable Karnataka to become a vibrant Knowledge society. It also aims to encourage the online use of Kannada. It is a Wikipedia type portal which will become the encyclopedia of all information in Kannada. The farmers, rural students, backward classes, homemakers (house wives) etc., will be the beneficiaries in addition to researchers and academicians.

The portal Kanaja serves as a source of information on various issues in Kannada. The portal is updated constantly. The portal has separate sections for Kannada language and literature, Science and Technology, and Agriculture. It also offers viewers participation in updating the information. The information posted by the viewers is posted on the portal after verification by an expert committee. The portal has more than 10 million words, 8500 articles and 228 books. It must be noted that the visually challenged can also avail this facility through e-speak software.

3.7 ODU PUTANI – Upgrading Indira Priyadarshini Children's Library as a Resource Center for Other Children Libraries

This project of Knowledge Commission aims to upgrade Indira Priyadarshini Children's library presently located in Cubbon Park, Bangalore into an invaluable resource center for the children of various schools of Karnataka in the fields such as Science, Technology, Mathematics, Music, Culture, History, Inventions, and Innovations etc. in collaboration with Department of Public Libraries. It is envisioned as a "Model library" which proactively engages students in the form of competitions and workshops and offers free access to the internet, encyclopedias and dictionaries. The objective involves conducting group video shows, workshops, seminars and competitions and other activities during normal and vacation periods. The Department of Primary and Secondary Education, Department of Public Libraries, Department of Horticulture, Department of Women and Child Welfare have participated in this project. In fact, it is a good example for inter departmental co-ordination in Government of Karnataka in resource mobilization, infrastructure, innovative activities and mechanisms. This would attract large number of children and such visits would trigger library habit among them.

3.8 SAHAYOG – Collaboration to Improve Employability of Undergraduate Students

The primary objective of Sahayog (meaning collaboration in Kannada) is to improve the employability of undergraduate students of Karnataka by imparting training to them in vocational and life skills. Of the total 120 hours of training, 80 hours is spent for imparting vocational skill training and the remaining 40 hours is spent in giving life skill training to the participant students. Skill component is missing in the curriculum of undergraduate courses. This will take off in Government colleges to start with and then, will be extended to others. It is a joint initiative of Department of Collegiate Education (DCE), Karnataka Vocational Training and Skill Development Corporation (KVTSDC) and Karnataka Knowledge Commission.

The First phase of the project was held during 2009-10 when nearly 7000 students from 112 Government colleges of the state were trained. After this successful endeavor, during 2010-2011, 13,363 students from 223 government first grade colleges of the state were selected and trained. A manual on life skills was prepared both in English and Kannada and distributed to students. A comprehensive evaluation and assessment of the project was carried out by Bhavan-Marshal Centre for Management Research. ICFAI Business School developed a case study on this.

3.9 SAMARTH – Strengthen and Empower Teacher Resource Institutions

Project Samarth aims at developing, strengthening and empowering DIETs (District Institute of Education and Training) as decentralized lead resource institutions by better empowerment, freedom and proactiveness. Project proposals of seven DIETs were supported by Karnataka Knowledge Commission with the active co-operation of Department of Primary and Secondary Education and DSERT.

During first phase, a visioning workshop was organized for all the DIETs and CTEs of Karnataka. Based on the outcome of the workshop, specific goals and action plan were chalked out. Later at a state level workshop, a revised action plan was prepared. In the second phase, the DIET's are required to come out with a project proposal based on the context and needs of their particular district and submit a proposal to KJA for guidance and grants to implement the project. Center for Leadership and Management in Public Service(C-LAMPS) and RV Education Consortium were the resource institutions to mentor DIETs in their projects under Samarth.

3.10 SWASTHYA – State-level Program for Preventive Health Care

Swasthya is an initiative which aims at designing and launching state-level programs on preventive health care (Swasthavritta) and initiating retrospective research studies to identify good traditional health practices which will contribute

to enhance self-reliance in public health care. It is observed that today region-specific health needs are generally overlooked, family and individual life style corrections are not focused, and preventive medicine is totally neglected. Hence, the basic causes of disease persist thus affecting the quality of life. The traditional and regional knowledge helps greatly to empower individuals with proper knowledge of health. Hence, Swasthya is a project to identify good traditional health practices, create awareness on health care, improve health practices, examine region specific health needs, and evolve an integrated approach towards preventive health activities. It also envisages combining Ayurvedic practices in respect of national health programs. This would be a module for need-based health awareness education and care that in a long run contribute to the rise in the quality of public health and also help in conserving the valuable medicinal resources of nature.
This project has mainly three components: Health Awareness, Health Education and Health Care. Initially few taluks of the state may serve as sample for this ‘Citizen Health Empowerment Drive’. This program activity includes publications, field visits, lectures, workshops and interactions, demonstration, exhibitions, regular periodical health care camps for preventive and therapeutic purposes and family health care through physical and mental rejuvenation and harmonization techniques.
Department of AYUSH implemented Swasthya as a pilot project in six selected districts of the state in two phases. In the first phase, Bangalore (Urban and Rural), Sirsi and Bijapur and in the second phase Mysore (Rural), Dharwad (Rural) and Mangalore were included. The implementation of this project is in collaboration with local NGOs, educational institutions especially government institutions, Taluk Panchayats, local Ayurvedic practitioners etc. The project is executed by Ayurveda Academy under the guidance of Department of AYUSH, Karnataka Government.

3.11 Summary Profile of KKC First Phase

The summary ontological profile for all the ten projects in the first phase is shown in Figure x below. The parenthetical number adjacent to a category in the ontology indicates its frequency of relevance to the ten projects – 0s have been omitted to avoid clutter. The actual frequency ranges from 0 to 8 although 10 is the possible maximum. Categories relevant to 8 or more projects have been colored red; those relevant to 4 to 7 projects have been colored orange; those relevant to 1 to 3 projects have been colored yellow; and those not relevant to any project have not been colored. Thus, the figure provides a synoptic view of the KKC projects through the lens of the Triple Helix Ontological Framework; the colors show the ‘hot’ and ‘cold’ spots.

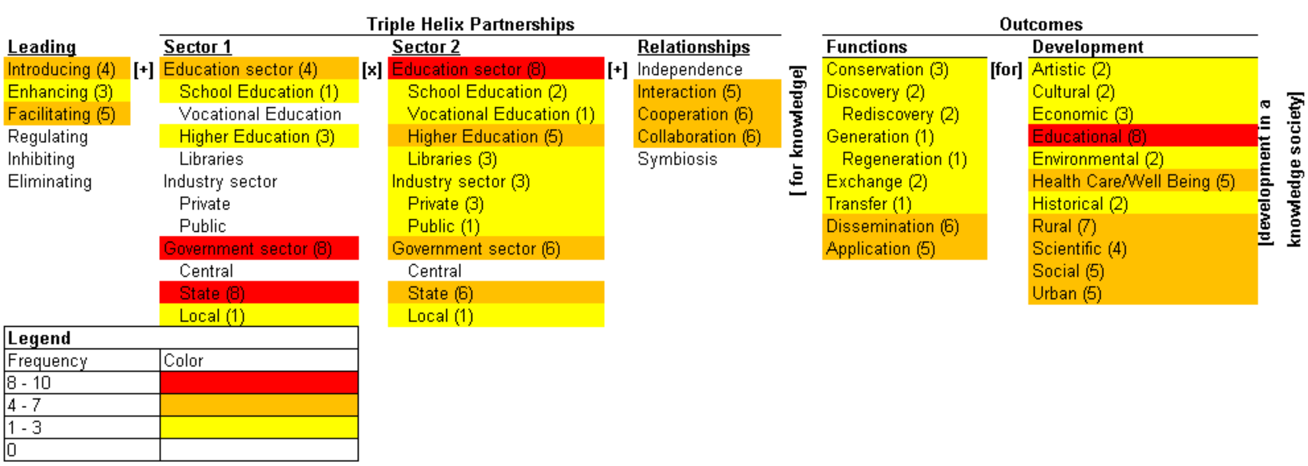

Fig. 2. Summary Profile of KKC First Phase

The ten projects taken together cover the full range of outcomes in their functional and developmental focus – there is at least one project which addresses each category. The emphasis varies between categories. The highest emphasis is on educational development; the second highest is on rural development, health care/well-being, social development, urban development, and scientific development. The least emphasized are economic, artistic, cultural, environmental, and historical development. Similarly, dissemination and application of knowledge are the most emphasized functions; conservation, discovery (rediscovery), generation (regeneration), exchange, and transfer are less emphasized.

In the Triple Helix partnerships, the emphasis is on the middle set of relationships – interaction, cooperation, and collaboration. Independence and symbiosis are absent in the projects. The primary partners are the Government sector (especially the state government) and the Education sector; the Industry sector plays a secondary role. Within the Education sector, Higher Education is the dominant partner.

The most common focus of the projects is on facilitating and introducing partnerships, followed by enhancing them. None of the projects focus on regulating, inhibiting, or eliminating partnerships.

1. 4. Discussion of Results

There is no normative profile of Triple Helix partnerships to compare the KKC profile. This is the first mapping of its type; hence, there is no basis for historical comparison either. In the following, we will discuss the KKC profile with reference to a hypothetical ideal that the whole ontological map should be red – that is, the projects should be numerous and uniformly cover all categories of the ontological framework. In such a case, it is unlikely that a single project could be comprehensive; the portfolio of projects would have to be highly differentiated and integrated – differentiated in the coverage of the framework, integrated in the mix of 'hot' and 'cold' spots. We will consider the partnerships, outcomes, and the leadership role in order.

There are nine possible types of Triple Helix partnerships: (1) Education – Education, (2) Education – Industry, (3) Industry – Education, (4) Education – Government, (5) Government – Education, (6) Industry – Industry, (7) Industry – Government, (8) Government – Industry, and (9) Government – Government. The nine types and the locus of the ten KKC projects are shown in Table 1below – many projects have multiple locus. Red colored cells indicate the highest number of projects, orange cells indicate fewer projects, yellow cells the fewest, and uncolored cells none.

Table 1. Triple Helix Locus of KKC Projects

		Sector 2		
		Education	Industry	Government
Sector 1	Education	Innovative Universities Samarath Swasthya	Daksha Swasthya	Samarath Swasthya
	Industry		Innovative Universities	
	Government	Arivu Dravya Kosha Kanaja Odu Putani Sahayog Samarath Swasthya	Daksha Jnana Fellowship Swasthya	Arivu Innovative Universities Jnana Fellowship Kanaja Sahayog Samarath Swasthya

In the KKC projects the Government and the Education sectors are the most dominant partners; Industry sector partnerships are few. Further, within the Government sector the State Government is the key partner; and within the Education Sector Higher Education is the key partner. Thus, while there is a wide range of partnerships the dominant one is between the State Government and Higher Education. This may be an appropriate starting point for the KKC given its mission to develop a knowledge society, but the successful accomplishment of its mission will likely depend upon increasing the range of partnerships, especially with the Industry Sector. This could be addressed in the second phase.

The partnerships emphasize interaction, cooperation, and collaboration. They do not explicitly recognize independence and symbiosis. On the one hand, the independence of the sectors is their natural state. Yet, an affirmation of their independence in the context of the partnerships would likely lead to a more effective partnership – it would permit simultaneously high differentiation and integration. Thus, for example, a higher education sector which is independent and acts in partnership with the state government could be more effective than when the higher education sector is dependent on the state government for most of its resources and is also a partner. In fact, such independence is hinted at in the Innovative Universities proposal. The former could be a partnership of equals, the latter of unequal. By the same token, symbiotic partnerships may emerge over time as the relationships mature. It may be too early in the lifecycle of the KKC projects to develop symbiotic partnerships.

The mapping of outcomes by projects is shown in Table 2 below. The emphasis on educational development outcome is understandable; and that on other outcomes is commendable. The different types of developments are deeply intertwined with each other and these interactions have to be explicated and understood. Thus, educational development could be the entry to other types of development. There is strong evidence, for example, that education development can lead to improved health and wellbeing. At the same time, each type of development has its own special requirements which need to be recognized. The KKC projects cover the full spectrum, albeit with different emphasis. Moreover, the emphasis on educational development may also be a consequence of the emphasis on partnerships between the government and education sectors. Explicit emphasis on the other types of development may require architecting different types of partnerships. For example, emphasis on health care development may need greater partnerships with both the private and public components of the health care industry; or, emphasis on scientific development may need true Triple Helix partnerships between the government, education, and industry sectors.

Table 2. Knowledge Development Locus of KKC Projects

		Knowledge Function						
		Conservation	Discovery/ Rediscovery	Generation/ Regeneration	Exchange	Transfer	Dissemination	Application
Development type	Artistic	Odhu Putani			Kanaja	Kanaja	Kanaja Odhu Putani	
	Cultural	Odhu Putani			Kanaja	Kanaja	Kanaja Odhu Putani	
	Economic	Odhu Putani			Kanaja	Kanaja	Kanaja Odhu Putani	Sahayog
	Educational	Odhu Putani	Innovative Univ.	Innovative Univ.	Jnana Fellowship Kanaja	Kanaja	Arivu Innovative Univ. Kanaja Odhu Putani Samarath	Daksha Innovative Univ. Sahayog Samarath
	Environmental	Odhu Putani			Kanaja	Kanaja	Kanaja Odhu Putani	
	Healthcare/ Wellbeing	Dravya Kosha Odhu Putani Swasthya	Dravya Kosha		Jnana Fellowship Kanaja	Kanaja	Kanaja Odhu Putani Swasthya	Swasthya
	Historical	Odhu Putani			Kanaja	Kanaja	Kanaja Odhu Putani	
	Rural	Dravya Kosha Odhu Putani	Dravya Kosha Innovative Univ.	Innovative Univ.	Jnana Fellowship Kanaja	Kanaja	Innovative Univ. Kanaja Odhu Putani Samarath	Innovative Univ. Sahayog Samarath
	Scientific	Dravya Kosha Odhu Putani	Dravya Kosha Innovative Univ.	Innovative Univ.	Kanaja	Kanaja	Innovative Univ. Kanaja Odhu Putani	Innovative Univ.
	Social	Odhu Putani	Innovative Univ.	Innovative Univ.	Jnana Fellowship Kanaja	Kanaja	Innovative Univ. Kanaja Odhu Putani	Innovative Univ. Sahayog
	Urban	Odhu Putani	Innovative Univ.	Innovative Univ.	Jnana Fellowship Kanaja	Kanaja	Innovative Univ. Kanaja Samarath Odhu Putani	Innovative Univ. Samarath

The emphasis on the dissemination and application of knowledge is understandable in the short term but may need to evolve in the long term. It is a good sign that all the other functions of knowledge management have been emphasized at least in one project. These emphases have to evolve over time, driven by both endogenous motivations and exogenous needs. As with development, the different knowledge functions too interact with each other. Discovery or rediscovery of knowledge, for example, could lead to new applications. These interactions too have to be explicated and understood to manage the portfolio of knowledge functions.

There is an asymmetry in the emphasis on leadership functions which is understandable in the short term but will need to be rectified in the long term. The emphasis on introducing, enhancing, and facilitating is appropriate and necessary in the initial stages of establishing the Triple Helix partnerships. It would be optimistic to expect all the partnerships to continue to be functional always. The partnerships will likely need to be regulated to maintain the independence of the sectors and sustain their interdependence through partnerships. The higher education sector's strength arises not only from its partnerships with the industry for research and placement of its students but also from its independence in pursuing research and formulating a curriculum. Regulation will be critical to maintaining the differentiation and integration of the sectors and their components. Further, some partnerships or aspects of the partnerships may have to be inhibited or eliminated when they become non-functional or dysfunctional. For example, industry-university research partnerships which encroach upon the academic freedom of the faculty members to publish in peer-reviewed journal may have to be excised. However, this asymmetry may be rooted in a deeper bias – a bias towards building partnerships, Triple Helix and other, rather than on regulating them and dismantling them.

2. 5. Conclusion

The present profile of the KKC projects may be a product of conscious design, unconscious bias, opportunism, and serendipity. They cover a broad swath of the Triple Helix ontological framework but not completely or uniformly; they are differentiated but not tightly integrated. At the same time it is not certain that such coverage is necessary for accomplishing the Commission's mission. The Triple Helix ontological framework and mapping the projects on to it, individually and in the aggregate, highlights the differentiation between and integration of them. The maps also show opportunities for further differentiating and integrating the present and future projects. For example, Sahayog could be extended to include partnership with the industry sector; and, Kanaja could be extended to include discovery and rediscovery of knowledge.

Thus the ontological mappings of the projects provide a concise comprehensive method for assessing the KKC's projects to-date and plan its future trajectory. It can be used to architect future projects and redefine present projects to ensure greater differentiation and integration to fulfill the Commission's mission. The ontological framework could itself be refined and extended. For example, it may be useful to add the informal education sector and non-government organizations into the framework. These too can play an important role in the Commission accomplishing its mission.

References

Ramaprasad, A. & Sridhar, M. K (2011). Empowering a state's development of a knowledge society. International Journal of Technology Management and Sustainable Development (10:1), 11-25

COOPERATIVE OF BALLOT AS AN INSTRUMENT TO BRING PEOPLE SOVEREIGNTY FOR FOUNDATION OF TRIPLE HELIX IN DEVELOPING COUNTRIES

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Abstract
Current global crisis that eventually also hits OECD countries should raise our awareness of the effectiveness of triple helix model, even in developed countries. However in developed countries currently suffering the crisis, there are regions that stand still almost unaffected. Trentino-Alto Adige in Italy and Basque Country in Spain are good examples of these strong regions. Thus instead of studying the triple helix in the country level only, we should also study the model in the smaller level.
Moreover we also identified several significant factors that determine the success of triple helix model. Particular from those two regions in Italy and Spain we have mentioned before, which once had history
of separatism, we draw conclusions of the importance of people determination and sovereignty to impose policy in favor of triple helix model.
Triple helix lacks of modeling other institutions that have role and interest in triple helix' field may raise severe problems in the success of the implementation, particularly in developing countries. In a country like Indonesia, where corruption rate is very high, as a symptom of unholy interest in the system, the triple helix model is not sufficient, because it somehow assumes that other institutions sincerely have the same goal as triple helix. In fact institutions outside the model often intervene triple helix cause, in this paper we will concern the parliament.
Numerous corruption cases involving members of Indonesian parliament are clear signs of this intervention. As an institution representing sovereignty of the people, there is no way for triple helix to get rid of them. Triple helix institution can only bow or lose against their member personal interest. However we have to tackle this problem in order to provide a better roadmap for the triple helix concept. As we have identified the important of people sovereignty for the success of triple helix, it is fundamental to have parliament members that really represent the people sovereignty.
This paper proposes a novel revolutionary fundamental solution to bring people sovereignty. Our proposal does not demand any change in current democratic system that we have built and fighted for, instead it utilizes the system into its full potential.

Keywords: people sovereignty, cooperative, ballots, parliament, money politics

1. Introduction

Current global crisis that eventually also hits Spain should raise our awareness about the e ectiveness of triple helix model, even in developed countries. However in Spain there is a region that stand still almost una ected, i.e. Basque Country region. Other interesting region is province of Bolzano in Italy. This province is interesting because Bolzano has very good economics indicators even though Italy is infamous for the corruption [Tra12]. Thus after observing these two regions, instead of studying the triple helix in the country level only, we should also study the model in the smaller level.

These two regions are very interesting, because they have amazing achievement far beyond their countries. Moreover despite their central governments are still ghting very bad statistics in economics and corruption, these regional government successfully overturn these statistics. If true sovereignty belongs to the people, who in turn delegate it to their governments [Sor04], using reversed reasoning we argue that a good government which adheres to people's mandate which entrusted to them, is chosen by truly sovereign people/society. From this argument we examine the development of of these two regions, and extract the gist of their success ingredient. We conclude that people's sovereignty is the important ingredient of the achievement of these region.

Meanwhile in Indonesia and typical developing countries, corruptions rampage all state institution. We consider this may happen because the true sovereignty does not belong to the people. Thus we propose a concept to bring people sovereignty as a foundation for development of developing countries particularly Indonesia.

2. State of the Art

Our reference should be a good model, but also realistic enough considering current real condition of Indonesia, so in the end we will also have a realistic roadmap. Indicators which matter in the similarity comparison are democracy, economics and corruption. We consider countries like Italy and Spain are suitable reference model for developing countries because among the democratic developed country, these countries have the most similar indicators with developing countries. For example, currently Spain has 23 percent of unemployment1and Italy in 2011 ranked 69 world wide in corruption perspection index according to Transparency International (meanwhile Indonesia ranked 100) [Tra12].

We choose Bolzano in Italy and Basque Country in Spain as our model instead of the whole country. Our choice of certain region of these countries in the hope that it would be less complex to analize. These regions just have made a success story of rapid improvement in last several decades, thus we consider that it would cover latest world development and condition.

3. Methodology

The gist of the idea was mostly synthesized from observation of Italy and Spain, particularly Bolzano and later Basque Country due to these regions interesting achievement. Then to have deeper understanding on historical background and to give theoretical foundation, we conduct analysis through review of the literatures, news analysis and also interview. Having the gist of their success, we then try to approach the problems in Indonesia.

We identify the problem in Indonesia mostly from daily life and news analysis. Then we go deeper through literature review, and particular to local problem (and neighbouring region) we conduct some interviews to the protagonists, e.g. campaigner team member in county level legislature, and village head election candidate/campaigner.

4 Finding and Interpretation

4.1 Bolzano and Basque Country

We identi ed some similar patterns between Bolzano and Basque Country. Italy annexed Bolzano from Austria during the rst world war, where at that time the majority were german-speaking people. Mussolini ordered the Italianization of the region that took e ect until after the second world war, where the german-speakers were marginalized. Even though Bolzano obtained status of autonomous region in 1948, still the life was quite miserable. Under that condition the people embraced a movement for self determination, formed political party and conduct non violent and violent action to raise people's awareness and to attract international attention. After a long struggle, nally Bolzano obtained an improved autonomy status in 1972 that provided important foundation for subsequent development [Alc01]. From that time, Bolzano has been evolved and become one of wealthiest regions in europe and wealthiest province in Italy [Eur11].

To accommodate people's hope, some local political parties were established. Major big local party in Bolzano is SVP, which splitted into several other local parties. Historically these local parties or their coalition have always been triumphant over national parties [Adi98].

2Basque Country had been an autonomous region since eleventh century. But this region lived under pressure after Spanish civil war, when Franco's regime forced Castillanisation of Basque region, that abolished the autonomy and enforced centralized government. This circumtance provoked the reactivation of a local political party, PNV. However the moderate political activity of PNV raised unsatisfaction to radical group (ETA) that embraced violent action. The movement was immediately suppressed by the authoritarian government, so they had to wait until the regime collapsed. Fortunate chance of autonomy came after the death of Franco that marked the end of his regime, together with the formation of autonomous region in other part of Spain [Cha11].

3Similar to Bolzano, in Basque Country the winner of the regional election has been also local parties or the coalition of local parties4. The elected government successfully formulated excellent policies that fostered sustainable development in Basque Country. Their highest regional GDP per capita in Spain is undeniable proof of their success story [Eur11]. Even under the pressure of economic crisis that currently hits Spain, in the beginning of 2012 Basque Country stands still with 12.1 percent of unemployment rate

5meanwhile ~~Spain has 23.6 percent. This achievemen~~t shows that the will of people in Basque Country has been channelled through the right choice in the regional election.

We can observe similarities of development between Bolzano and Basque Country. The people's awareness and determination grow from regional identity. Their determination to have a better life fostered into an idea to have a sovereign region as a manifestation of people's sovereignty. Needless to say this idea would be clash with the policy of central government. In the end their determination ends up into an autonomous region, however an acceptable autonomy can be thought a kind of sovereignty [Alc01].

The triumph of local parties in the election shows people's determination of having better regional government than the central government. The achievement of these regions as wealthiest region in Italy and Spain proves that the elected regional government has made good policies that concur with interest of the people. In other words people have made the right choice during regional election, the choice that can accommodate their hope, thus represents the people's soveregnty in the government.

Thus from those findings we conclude that there are several stages of the development:

Awareness. Initially people must be aware that they are living under pressure, instead of living in denial and pretending everything is ne. Awareness of the situation is not enough, people must be aware of their potential as well. People must be aware of having ability to change their life.

Determination. Strong will to have a better life must be nurtured. Often it needs sacri ce and ghting. To maximize its e ectiveness, it needs a good environment in the form of a community which consists of people with the same idea. In the case of Bolzano and Basque Country the organization emerged in the form of political party.

People's sovereignty. The nal stage is molding people's sovereignty into sovereign region. Clearly this kind of separatist idea is hardly acceptable by a sovereign country. Thus this idea was implemented into autonomous region.

Even though we can not have apple to apple comparison of these cases with the case of Indonesia, we shall approach the development in Indonesia using those similar stages.

4.2 Indonesia

Indonesia emerges as a democratic country just shortly after the fall of Soeharto's government in 1998. However after a decade of development, we are still living under harsh corruption. Corruption rampages all state's institutions, executive, legislative council and even the judiciary. To overcome this we have set up a corruption eradication commission institution (KPK) and a special judicial for corruption (Pengadilan Tindak Pidana Korupsi). Particular to the corruption cases of executive and legislature, many believe that the corruption is the payback for the high political cost due to money politics(see also [Les]). Indonesia has a long history of money politics, from the level of grassroot to the elite. Obvious example in a grass root level is the election of village head. This event is notoriously known for betting. The winner of the election sometimes is not the one in favor of people's choice, but the one in favor of bet dealers who buy the ballot from the people. So far what we have done to minimize this problem is to held the election of many villages in one day, in a hope that the bet dealers cannot cover all villages.

The practice also occurs in higher level during the regional head election such as city mayor, head of county, and governor of province [Bum10,Les]. Not only in executive election, money politics and corruption also rampage the legislative election [Alk08]. Unlike money politics in village head election that often only for amusement of gamblers, in higher level the impacts are miserable. Politicians in higher level may pass laws or policies in favor of the politicians' funding father instead of in favor of the people who delegate the mandate.

These cases are clear sign that the people's mandate was delegated to the wrong persons who betray it. Thus people's sovereignty is not actualized in the government and its policy.

Recalling the development stages of Bolzano and Basque Country, awareness, determination and people's sovereignty, in those stages Indonesia is still in the stage of raising awareness. Unlike the case of Bolzano and Basque Country which got pressure due to their identity and culture, the pressure in Indonesia is about economics and uncertain future. Economics pressure is very imminent in middle lower class of society, considering the GDP per capita is merely US $2920 [Sta11]. Meanwhile in higher society class the uncertain future fostered in the form of pessimistic thought which are demonstrated through non-voting community [Sub09,Yan] and revolutionary thought to start over everything. These pessimistic thought is pretty plausible considering current Indonesia's political situation that can be depicted as following. Political bargaining is done with a political party approaching a community, o ering promises and proposing candidate. Often, there are cases where the candidates are merely public celebrity gure to draw people's ballots.

We want to reverse this bargaining mechanism. We want the community gather together to discuss their goal and petri ed their determination. Then having a number of ballots, these people approach the party to o er their ballots and ask for parliamentary seat for their own candidate.

5 The Proposal of the Solution

5.1 Conceptual View

This paper proposes a novel revolutionary fundamental solution to bring people's sovereignty. Our proposal does not demand any change in current democratic system that we have built and ghted for, instead it utilizes the system into its full potential.

We call our proposal as "cooperative of ballot" concept. The term cooperative exactly has the same notion as in economic context. Thus, instead of economic capital, it will transform political capital, i.e. ballots, into economic advantage. The ability to present the transformation of ballot into quantitative economic bene t is very important for marketing purpose of the concept, as we have noted that Indonesia has long history of money politics from the level of grass root to the elite.

Even though from the surface it may look like to legalize money politics, deep inside the concept, it raises people's conscience of the importance of their ballots and their sovereignty. The attractiveness of money is merely for marketing purpose. In brief the concept of \cooperative of ballots" works as follow. A group of people which consists of at least a number of election threshold gather together to establish a cooperative of ballots, thus they should be able to have a parliamentary seat to represent themself in the parliament. Then constitutionally, they have to channel their vote through a political party, this is the weakest link. The cooperative of ballot bargains with the political parties:

- the cooperative demands a county level seat and gives the vote for provincial and national level to a political party
- the coooperative threats big political parties about giving cooperative votes to the party competitors or small/new parties.
- in the worst case cooperative bargains with small/new political parties. Such parties are very good targets for their lack of budget, and their popularity.

We reemphasize the notion of parliament member as a representative of the voters. The cooperative should choose a person to act as a spokesman, instead of a leader. Thus he is merely an employee of the cooperative who is being outsourced into the parliament. All of his income should go to the cooperative and then the cooperative determine his salary, note that from cultural point of view, this matter is very sensitive and may become a determinant factor in this concept. He should knee in front of the cooperative but with full support of cooperative member he should stand strong in the parliament. However since the representative might be an uneducated person, to have the best advantages of having a seat in parliament, the cooperative may hire a professional on certain related eld where the cooperative members do not have expertise.

We are aware that there may be conflict of interest among cooperatives of ballots, however this is normal in democracy. Using this concept we guarantee the democracy always in favor of the interest of people instead of the interest of money. Thus as a side e ect, this concept will eliminate the practice of money politics.

5.2 Practical View

The practical level of this solution may not perform well, considering people scepticism caused by current political situation. We need a smart campaign and pilot project to convince the people. Thanks to today's information technology which come up with internet. Internet have been proven efective in Arab springs revolution. Particular to the case in Indonesia around 1998 reformation, internet also gave significant contribution [Lim05].

We propose two categories of action in the practical level: Voters education. This action is meant to raise voters awareness. Theubiquitos corruption cases have raised people's awareness that this condition is not what they wanted, but they feel helpless with it. Thus, reeducate this matter might be annoying instead of enlighting. Our task is to show their potential to change this condition. We shall show them the scenario how to actualize their power. The educational tools should be convincing and simple, even for the least educated voters. Remember that voter's inteligence doesn't count in the ballot of one man, one vote election system. We propose short stories, pictorial stories (comics) and computer simulation games for the tools of voters education. The dissemination of this educational tools will be pretty trivial due to the availability of internet. However paper based media is still very important to reach all people.

Shadow election. This tool is meant to provide a simulation of the election using real voters participation. Through this shadow election we shall gather people's ballots and precompute the value in economics term. Hopefully this mechanism can convince people about the real value and power of their ballots. Finally using the ballots obtained, we shall be able to make bargain bargain with political parties to have our own candidates in the general election. Currently our proposed tool for implementing this action is using internet application.

6. Policy Implication for Future Research

We have identified people's sovereignty as important factor that determines the success of triple helix. We propose a solution to establish people's sovereignty within a context of cultural and political system of Indonesia as a case study of a developing country. When the parliament really represents people's will, that is inherently the same as triple helix goal, definitely their policy will concur with triple helix. Thus it will support triple helix model automatically. The future work is obviously to implement the concept of cooperative of ballot in the nearest election, 2014.

References

[Adi98]Regione Autonoma Trentino-Alto Adige, Elezioni Del Consiglio Regionale, Regione Autonoma Trentino-Alto Adige, 1998.

[Alc01]Antony Alcock, The South Tyrol Autonomy, A Short Introduction, 2001.

[Alk08]Artidjo Alkostar, Mengkritisi Fenomena Korupsi di Parlemen, Jurnal Hukum 15 (2008).

[Bum10]Daniel Bumke, Chal lenging Democratisation: 'Money Politics' and Local Democracy in Indonesia, Political Studies Graduate Conference 2010 (2010).

[Cha11]Petra Chaloupkova, Accommodation of Substate Nations Through Territorial autonomy: South tyrol and The Basque Country Compared, Master's thesis, 2011.

[Eur11]Eurostat, Regional GDP per Inhabitant in 2008 , 2011.

[Les]Teddy Lesmana, Politik Uang dalam Pilkada .

[Lim05]Merlyna Lim, Archipelago online : the Internet and political activism in Indonesia, Ph.D. thesis, Enschede, September 2005.

[Sor04]George Soros, The People's Sovereignty, 2004. [Sta11]Biro Pusat Statistik, Data Strategis BPS , Biro Pusat Statistik, 2011.

[Sub09] Nyoman Subanda, Analisis Kritis terhadap Fenomena Golput dalam Pemilu , Jurnal Konstitusi I (2009).

[Tra12]International Transparency, Corruption Perception Index 2011, 2012.

[Yan]Sri Yanuarti, Golput dan Pemilu di Indonesia

Advancing the Small and Growing Business (SGB) Movement in Colombia: ImpactA a SGB Collaborative Multiactor Acceleration Program

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Abstract

Despite significant progress in building a dynamic and enabling environment for entrepreneurship, Colombia still lacks a cohesive ecosystem of support for Small and Growing Businesses (SGBs). The lack of an appropriate aligned supply of services required to overcome the "valley of the death", is one of the fundamental challenges. A joint effort of organizations with undisputed credibility in the country and in the region (Universidad de los Andes School of Management, Bavaria Foundation, Avina Foundation, Endeavor Colombia, Ventures and Compartamos con Colombia) has brought together the SGB Collaborative Acceleration Program "ImpactA", aimed at becoming the country's point of reference for SGB development and the leading venue for investment possibilities.
Keywords: SGB, collaboration, ecosystem, entrepreneurship, acceleration

1. Introduction

Despite significant progress in building a dynamic and enabling environment for entrepreneurship, Colombia still lacks a cohesive ecosystem of support for Small and Growing Businesses (SGBs). The lack of an appropriate aligned supply of services required to overcome the "valley of the death", is one of the fundamental challenges. A joint effort of organizations with undisputed credibility in the country and in the region (Universidad de los Andes School of Management, Bavaria Foundation (SAB Miller Subsidiary), Avina Foundation, Endeavor Colombia, Ventures and CCC) has brought together the SGB Collaborative Acceleration Program "ImpactA", aimed at becoming the country's point of reference for SGB development and the leading venue for investment possibilities.

This inter-organizational collaborative program is an excellent example of the Triple Helix model. It is conceived as the result of multiple conversations among key players of the ecosystem including government, university and the private sector. This paper intends to address in detail the design, planning, execution and key lessons of the program.

2. The problem or need being addressed

Colombia has made remarkable progress in overcoming security-related challenges and building an enabling environment for business development. Programs like the World Bank's Doing Business and the Global Entrepreneurship Monitor have acknowledged this process, recognizing the positive effects of recent regulations and the remarkable entrepreneurial drive of the Colombian people. The development model adopted by Colombia recognizes the power of business and entrepreneurship to drive sustained economic growth, improve the living conditions of its population and promote the sustainable use of natural resources.

During the last decade, sustained economic growth and government policies have promoted microfinance and private sector investments, generating growth particularly in the segments of microenterprise and corporations. Meanwhile, Colombia's SGB sector continues to operate at a suboptimal level.

Universidad de los Andes School of Business and Bogota's Economic Development Bureau (2010) studied Bogota's (Colombia's capital city) entrepreneurial ecosystem and the existing relationships between 155 active players providing different sorts of services or support to SGB's in the city (Guerrero et al., 2010). Structural barriers related to the support mechanisms exist, hindering the potential to deliver meaningful impacts to the country's environmental and social sustainability. The support ecosystem for SGBs continues to be fragmented and specialized support for SGBs that deliver social and environmental benefits to local communities remains scarce. Likewise, awareness of the challenges and opportunities faced by SGBs has not permeated this entrepreneurship environment. The following is a detailed description of the five trends which we observe in the Colombian entrepreneurial landscape: fragmentation, lack of focused support, low awareness, lack of comprehension of policy needs in the ecosystem and lack of an entrepreneurial culture:

- Fragmentation: Many programs and initiatives have flourished in the SGB sector, (business plan competitions, technical and academic service providers and private capital funds, most prominently), but coordination amongst them is weak and they often replicate one another. For example 85% of supporting organizations relate to a single other institution compared to 2% of institutions that have more than 30 active relationships with other institutions. This highlights an important situation in which institutions are offering "what they want" instead of "what they should", therefore limiting the necessary tools for entrepreneurs to succeed in their ventures (Guerrero et al., 2010). A shared vision amongst institutions and funds, where the key elements for ecosystem support for entrepreneurs and SGBs are identified, do not exist. Scenarios for the discussion of a shared vision are missing resulting in inefficient allocation of resources for SGBs.
- Lack of specialized support: Innovative SGBs with high potential for growth lack focused and specialized support. Most initiatives in the SGB sector focus on enterprise identification and incubation. Even though 55% of the ecosystem actors are universities or research centers, Guerrero et al., (2010) demonstrates that their interactions with other organizations that complement the value offer for entrepreneurs are fairly low. As a result, they have focused primarily on business ideas and startups and, exceptionally, offer a support network past a business plan contest itself. On the other side of the spectrum, there is a promising community of private capital funds and programs which finance more consolidated enterprises with investment capital needs over US$2 million, and revenues above US$5 million (Bancoldex et al., 2010). In this scenario, few programs accelerate or support SGBs which are past the start-up phase but have investment needs from US$100,000 to US$2 million. There is a lack of programs that engage the investment community (emerging private capital funds and angel investors) and understand the expectations of SGBs and prepare them for potential negotiations with investors. Likewise, methodologies for SGBs to report their social and environmental impacts are rarely disseminated.
- Low awareness: Challenges, opportunities, successes and failures in the local entrepreneurship/ SGB space need to be communicated consistently, in an effort to capture valuable lessons for the sector as a whole. Venues that bring together the key actors of a support ecosystem (entrepreneurs, investors, regulators and supporters) are important to advance the development of the sector. Furthermore, there are very few scenarios where different actors of the value chain interact and discuss with policy makers possible measures to nurture SGB's growth. (Guerrero et. al., 2010) show that government institutions within the ecosystem do not work in coordination but rather create individual networks to perform their duties.

- Lack of comprehension of policy needs in the ecosystem: Government has created a broad set of policies that address general aspects of the ecosystem, and some have been adopted from international models, but these may lack customization or specificity. Current results show that policies do not reach bottlenecks such as a lack of articulation among programs, the customization of services within programs and the disconnection between the ecosystem and sources of capital. Moreover, fiscal policies and other regulatory measures are not well suited to create a favorable environment for enterprise growth, especially for early-stage ventures. These regulations create significant costs for entrepreneurs limiting their working capital for growth (Salazar, 2011, p4).

- Lack of an entrepreneurial culture: According to Salazar A. (2011) there is a cultural un-acceptance for failure among the Colombian culture that results in risk aversion of both investors and entrepreneurs. This conservative mind-set is encouraged by the academic sector which is just starting to see entrepreneurship as a valid alternative for students. An incentive and communication strategy from the private, public and academic sector is needed to encourage young and mature entrepreneurs and investors to become part of the ecosystem

In summary, Colombia has taken important steps towards building a healthy and dynamic entrepreneurship landscape. Greater articulation between existing institutions and funds is needed to facilitate the flow of investment towards innovative SGBs with positive social and environmental impacts. An ecosystem of support should engage and operate in a coordinated manner, while providing targeted support to a growing number of entrepreneurs, generating awareness amongst policy makers on key issues for SGB development, and failure in entrepreneurship is a fact that should not be morally punished.

The following sections describe how this project aims to fill this gap and benefit the Colombian SGB sector at large.

3. How the problem is addressed

3.1. Purpose

The purpose of this project is to generate an innovative multi-actor collaborative initiative that addresses the main needs identified by key players of the entrepreneurship support ecosystem in the city of Bogotá-Colombia. The project aims at designing, constructing and operating an SGB acceleration program, pointing to high impact entrepreneurs as economic and social development catalyzers. Complementary strengths and competencies are sought within the founding institutions in order to maximize the efforts to increase impact in the ecosystem.

Short term objectives aim at achieving quick wins that demonstrate effectiveness of a collaborative approach and enable a better understanding and analysis of support services for entrepreneurs. Long term objectives seek the generation of an entrepreneurial culture that rewards failure and promotes risk taking, enhancing the development of SGBs through private sponsors, promoting knowledge transfer to entrepreneurship programs in the public sector as-well as public policy strengthening in the subject.

The Program has set up to meet the following specific goals:

Short term goals: Articulate services, resources, knowledge and competencies of six founding members to provide an acceleration program to a set of entrepreneurs identified as "high impact entrepreneurs" in Bogotá.

Long term objectives:

- Strengthen the entrepreneurship ecosystem in Bogotá
- Articulate various actors in the ecosystem as a way to promote collaboration and focusing efforts on creating value for SGB's rather than success stories of isolated programs or institutions.
- Accelerate high impact initiatives by creating tangible results within a limited timeframe.
- Connect ecosystem actors and entrepreneurs with useful tools and information across the ecosystem.
- Influence the culture of entrepreneurship by embracing failure as a path to success and recognizing entrepreneurs as an important asset for economic growth.
- Catalyze knowledge transfer for the development of similar initiatives across the country in alliance with the government.
- Influence public and private entrepreneurship programs by suggesting specialization topics that complement with other institutions' services and maximize value for SGB's

The SGB acceleration initiative provides a solution for the previously described problem by executing a pilot program for a sample of 5 to 10 SGBs. The pilot program is intended to last about one year and is divided into three phases. CCC will run a pre-operative phase for planning and design before executing activities. Phases 2 and 3are managed by a program coordinator.

Figure 1 shows the whole program structure.

Fig 1. Phases of the Project

Pre-operation tackles general aspects of the project such as design, the identification and formalization of needs as well as the commitments and basic guidelines for phases 1 and 2. Information flow between founders is defined, the basic acceleration methodology framework is constructed and program coordinator is recruited. Phase one is carried out by CCC.

Phase 0 should have as a tangible result:

- A cooperation agreement document signed by all the founder organizations and the commitments made by the institutions are formalized
- The basic guidelines of operation:
    - Governance and organizational structure
    - Invitation and selection criteria
    - Selection process stages
    - Acceleration process guidelines
- The recruitment of one full time staff member in charge of the program operation and coordination.

Phase 1 - SGB invitation and selection: The program coordinator organizes the invitation and selection strategy using a guideline and the documents prepared in the pre-operative phase. The selection process funnels companies through a set of criteria that results in the selected sample. The selection process is carried out and 5 to 10 SGB are selected for the acceleration process.

Phase 2 consists of the SGB acceleration process in which the program coordinator and the selected SGBs tailor specific programs for each business according to the result of a diagnosis session provided by one of the founder institutions. A detailed schedule with all the activities is provided to each SGB and the execution of those activities is carried out using a combination of services provided by all founder institutions.

3.2. General Framework

Six main topics have been defined for the acceleration program, which resulted from the discussions held by the founder institutions and the needs identified in the entrepreneurship ecosystem in Colombia from their previous work:

- Business planning and management
- Product / service quality
- Marketing and sales
- Talent and Innovation
- Access to financing
- Operational consolidation

The value offer for the selected SGBs is a set of customized activities designed to tackle the entrepreneurs' specific needs. Consequently, tangible results are expected within the duration of the program. The key elements of the value offer are:

- Diagnosis of key needs
- Detailed work-plan tailored to each company's / entrepreneur's specific needs
- Support in work-plan execution
- High level networking
- High level mentors
- Access to founder institutions' networks (financing, technical assistance, investors, clients, suppliers)
- Media exposure

It is expected that the combined services of the founder institutions will enhance the entrepreneur's experience.

3.3. Origins and founder organization´s backround

The initial discussions of the project where held by Universidad de Los Andes, Bavaria and CCC. However, structuring the program was the result of a joint Venture between CCC and Avina Foundation, in which the latter served as a financer. The multiple conversations led to the creation of a formal group of founder institutions that had resources to finance and consolidate the project. Once the group was consolidated the role of CCC was to design and evaluate potential alternatives for the program and facilitate discussions that leveled understanding of issues. As a result, the program, ImpactA, became a multi-actor collaborative acceleration model founded by; Universidad de Los Andes School of Management (UA), Fundación Bavaria (FB), Endeavour Colombia (EC), Compartamos con Colombia (CCC), Corporación Ventures (CV) and Fundación Avina (FA), which are all active players of the entrepreneurship support ecosystem.

The relevance and importance of this initiative is derived from the joint efforts of the six organizations mentioned. The following lines briefly describe each organization's activities as well as their main role in the project:

Universidad de los Andes School of Management

Contact: Andrés Guerrero, Director, Entrepreneurship Program

Universidad de los Andes School of Management has more than 35 years of experience training individuals capable of transforming Colombia's institutions and the country's social landscape, through programs at the undergraduate, graduate and executive education levels.

The School's academic excellence is accredited by internationally-renowned organizations: EQUIS (European Quality Improvement System) and AMBA (Association of MBAs). It is also part of different international organizations devoted to the practice of business and management education, such as EFMD (European Foundation for Management Development), AACSB (The Association to Advance Collegiate Schools of Business), Sumaq Alliance, which brings together the most prominent business schools in Ibero-America; CLADEA (Latin American Cousel of Management Schools) and Unicon (University Consortium), an association of the best centers and models of Executive Education worldwide.

In 2008, the School of Management established two strategic alliances aimed at strengthening its capacity to support Colombia's entrepreneurship landscape: World Resources Institute's New Ventures Initiative and Business in Development Network. With these alliances, the School began its SGB acceleration activities in 2008. In its first year of operation, the School's acceleration Program assessed 450 business plans, offered mentoring services to 70 SGBs and investment workshops to 20. The Program's first Investor Forum featured 25 SGBs and 15 investors from Colombia and abroad. It also featured a two day seminar that brought the business community together with academia and policymakers to discuss the opportunities for Colombia around green entrepreneurship.

The role of Universidad de los Andes School of Management in ImpactA is to provide access to classrooms and university facilities, and to assign last year business school students for specific projects, activity execution or consulting services for the program's SGBs. As a well recognized academic organization, ImpactA may benefit from the academic research community as well as gaining access to the best international academic networks. Furthermore, the university's close relationship with the local and national government provide an interesting set of tools for the long term objectives of the project.

Fundación Bavaria

Contact: Catalina García, Director, Bavaria Foundation; Blanca Ariza, coordinator, Destapa Futuro Program; Salomon Winograd, coordinator, Bavaria's Angel Investor Network

http://www.bavaria.com.co

Bavaria is SAB Miller's subsidiary in Colombia. One of the country's largest corporations, it is also a prominent actor in the country's entrepreneurship landscape through its Destapa Futuro Program and recently with one of the first Angel Investor networks in Colombia. Bavaria and its Destapa Futuro Program are focused on making a contribution in developing the Colombian society by influencing the flourishing national entrepreneurial ecosystem. After developing a program to support entrepreneurship adopted from the South African SAB-Kick Start case with 12 years of experience and with its own experiences accrued during the first three years of local implementation, Bavaria developed a Web-based tool to allow the compiling of information and a screening process to identify entrepreneurs, provide them with mentoring and consulting, enable them to make contacts without incurring in high costs and have access to sustainable funding. Through its *Destapa Futuro* Program, Bavaria has identified and trained over 900 entrepreneurs and selected a group of over 180 "dynamic" entrepreneurs as the winners of USD 5 million, through a carefully designed competitive process.

Destapa Futuro also allowed the establishment and expansion of an Entrepreneur Network - a web-based initiative that facilitates innovation by creating a connecting space and favoring close relationships between entrepreneurs, supported in the methodologies and functionalities inherent to the social network platforms to solve common problems. 14,000 Colombian entrepreneurs currently participate in the Network and are able to set role models for their own communities.

The main roles of Bavaria Foundation as a founder of ImpactA is to fund the program's operation, provide access to junior mentors and hosting networking events. As a highly recognized organization of the private sector as well as a mayor player of the entrepreneurship ecosystem, Bavaria serves as a high reputation platform bringing to the playfield its top executives to provide valuable advice and contacts to entrepreneurs involved in the program.

Compartamos con Colombia

Contact: Jose Francisco Aguirre, Excecutive Director

www.compartamos.org

CCC is a nonprofit founded in 2001 by 12 professional service firms operating in Colombia including international and local companies. CCC is an innovative social model were knowledge and resources from the private sector are channeled to create and support high impact and innovative social projects and approaches.

CCC's model is based on a collaborative effort between top tier professional service firms. Currently, CCC has 14 professional service firms that consider this model as one of their key social responsibility strategies. The partners include international organizations such as McKinsey&Company, JPMorgan, Citigroup, Deloitte, PriceWaterhouseCoopers, and BDO; and leading local companies such as BIBancolombia, Estrategias Corporativas, Inverlink, Advantis, Remolina&Estrada, Gómez Pinzón Zuleta, Prieto&Carrizosa, and Brigard&Urrutia.

CCC concentrates its efforts on three main strategic fronts: 1) Institutional Strengthening of nonprofit organizations, 2) Development of corporate social responsibility and sustainability strategies and 3) Social Innovation initiatives in which entrepreneurship has been a key driver through initiatives such as the creation of Ventures as an independent organization.

CCC has had the role of structuring ImpactA both on a strategic and operational level. It has provided a pool of knowledge derived from its partner institutions that has contributed to the design and evaluation of the model alternatives presented to the founder organizations. As a collaboration platform itself CCC serves as a connector both in the social and private sector.

Other contributions to ImpactA during the execution phases include: handling the recruiting process for the program coordinator, providing office space for meetings, identifying potential allied firms, facilitating workshops to strengthen specific entrepreneur competences such as communication and financial skills.

Avina

Contact: Daniel Gonzalez, Coordinator,

http://www.avina.net

Avina works at creating opportunities for systemic change in Latin America, linking and strengthening the individuals and institutions in the region that can drive that change. Avina broker's alliances around shared agendas for action that can contribute to a regionally relevant scale of impact. Through direct investment in these shared agendas, synergies and collaboration potential are identified with the work of other international organizations.

Avina works in Latin America as a broker, co-investor and facilitator, leveraging its resources, local presence and relationships with thousands of allies to incubate and scale up shared strategies for change.[3]

Avina has funded ImpactA's pre-operative phase and provided seed capital necessary to motivate the other funding institutions to economically support the project. Having a broad knowledge and presence in South America enables Avina to promote interactions and transfer best practices from similar processes around the continent as well as promote ImpactA as a successful case.

During the process it is responsible for the linkages between entrepreneurs and technical assistance, sources of funding and non-profit organizations worldwide as well as advisory in relationship strategy.

Ventures

Contact: Maria Mercedes Barrera, Executive Director

www.ventures.org

Ventures is a non-profit organization originally created by Revista Dinero, McKinsey & Co. and Ashoka 10 years ago with the purpose of generating an entrepreneurial culture in Colombia. It has been serving as the operator of one of the most

[3] Taken from: http://www.avina.net

important business plan contests in the country. It has awarded over 1000 entrepreneurs and involves more than 300 active members representing various private enterprises. The organization currently focuses in three main objectives:

- Grow the reach of the contest geographically and at the same time improve the quality of awarded projects. Recognize the need of articulation with the other organizations or institutions such as universities, private sector and government.
- Enhance business plan selection and validation processes by assuring the organizations economic stability, standardization of procedures and a high quality team.
- Provide post-contest services to award-winners or final round entrepreneurs such as access to funding, networking and additional mentoring.

On tackling its third objective, Ventures recently held an acceleration program with past winners of the contest with the support of CAF[4], as a response to the needs identified in their experience. Tasks, activities and feedback sessions were designed to create a sense of urgency in the entrepreneurs as a means to achieve short term results and plan medium and long term actions.

Ventures has provided funding for the operation of ImpactA and has the legal responsibility of the full time program coordinator. Additionally, it has the responsibility of linking the program with other operated programs or contests owned by them or their networks.

A decade of involvement with entrepreneurship has led Ventures to the creation of an innovative robust educational platform for entrepreneurs, from which ImpactA may capture the methodologies to produce fine-tuned business plans and a deeper understanding of the business models.

Nevertheless, the strategic alliance held with Revista Dinero, the most recognized business magazine in the country, serves as a showcase for ImpactA and entrepreneurs.

Endeavor

Contact: Gaia Domenicis, Excecutive Director

www.endeavor.org

Endeavor leads a global movement designed to catalyze long-term economic growth by selecting, mentoring, and accelerating the best High-Impact Entrepreneurs around the world. Endeavor helps entrepreneurs overcome barriers to growth by providing the key ingredients to success: mentorship, networks, strategic advice, talent, skills, access to smart capital, and inspiration. Guided by Endeavor, these entrepreneurs generate sustainable economic growth and jobs, become self-made role models, and help nurture a culture of entrepreneurship which spurs investment and encourages people to think big.

[4] The CAF is a development bank composed by 18 Latin American, Caribbean and European countries and 14 private banks of the Andean region. The institution promotes a sustainable development model through credit operations, non-refundable resources and the financial and technical support of projects in the private and public sector in Latin America.

Endeavor Colombia was launched in 2006 and since then has screened over 700 entrepreneurs. It has also positioned itself as a leader in the entrepreneurial sector, acting as a hub for activities, conferences, and country-wide discussions about entrepreneurship.[5]

Endeavour Colombia, as one of the global leaders of high impact entrepreneurship, has accumulated experience in diagnosis and mentoring entrepreneurs through high demanding criteria and milestone completion. ImpactA intends to capture best practices from these methodologies and adapt them to fit the program's scale without leaving aside the access to privileged trained senior mentors.

3.4. Governance and operating model

As a result of the preoperative phase the governance structure of ImpactA included a board of directors formed by two or three members from each founding institution. A coordinator was also identified to be crucial for executing the activities described in phases one and two (figure 2). The board of directors is in charge of determining a long term vision of the project thorough the establishment of a defined strategy. It also has to provide support to the coordinator's decision making process. Every two months, the program coordinator should produce an update report, emphasizing on specific achievements, comments made by mentors, issues and challenges. This bi-monthly report includes updates on administrative topics and will be presented to the board of directors.

From an operational point of view, each organization committed specific services and resources that should be delivered during the process as stated in the collaboration agreement. In terms of human resources, each organization should allocate a senior team member for decision making and a junior team member for operational support to the coordinator. The compliance of these commitments will be managed by the coordinator and reported to the board.

Fig 2. Organizational Structure ImpactA

4. How the project or program will create value for the sector and/or SGBs

By creating a credible meeting point for SGBs and initiatives interested in supporting their development, and offering a venue where SGBs, investors and the wider ecosystem of support comes together, ImpactA will be a key piece in advancing

5 Taken from: http://www.endeavor.org/network/countries/colombia/6

the debate around SGBs and their role in facing the challenges of poverty and environmental degradation in Colombia. Moreover, by working with and attracting SGBs from other initiatives focused on earlier stages of company development, the program will allow Colombia's SGB sector to operate in a more coherent way and allocate resources more efficiently.

Nevertheless, the six founding organizations have a broad network of connections not only with the entrepreneurial ecosystem but with the private and public sectors. This means the value offer for SGB's starts directly from these institutions' connections allowing entrepreneurs to "screen" their deals right from the beginning in different environments and facilitating a great deal of high value conversations.

Several organizations that are not currently part of this initiative are welcome to join ImpactA under various figures (ally, founder or financier) through founder institutions' invitation. This brings together the different elements in the value chain of entrepreneurship, and also sharing lessons with the broader business community.

Moreover, ImpactA can allow for better understanding whether an acceleration program should charge entrepreneurs a small portion of their company's equity or not ("equity oriented"). If the results show a tangible impact in sales, corporate governance, marketing, customers, or any other key business element there will be a way of quantifying the real value added by the program. This means that if the program's value offer proves real, then the opportunity of making the program self-financed through a small portion of SGB's equity can make sense, and therefore the founder institutions financial commitments more flexible. Some examples include Y Combinator or Tech Stars in the United States that have proven successful models in their acceleration programs (Angel Capital Association Summit, 2012).References should be listed at the end of the paper, and numbered in the order of their appearance in the text. Authors should ensure that every reference in the text appears in the list of references and vice versa. Indicate references by numbers in square brackets [??] in the text. The actual authors can be referred to, but the reference number(s) must always be given.

5. State of the art of the project

ImpactA is currently running a pilot acceleration program headed by the program coordinator and supervised by a board of directors. 5 businesses were selected by a committee out of 36 applications received, and specific diagnoses were carried out by Endeavor to determine the main areas of work for each business. Furthermore, senior and junior mentors were assigned to each entrepreneur under a multi-disciplinary model (figure 3) and specific work-plans for the acceleration program were constructed. The first meeting sessions between SGBs and mentors have taken place giving the program a lean start towards specific goals.

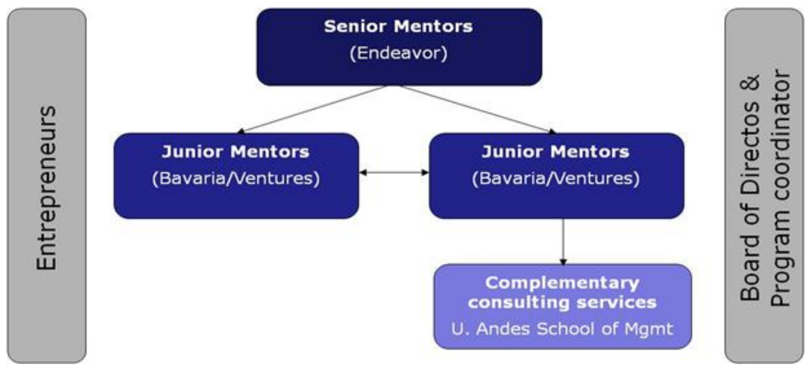

Fig 3. General structure of mentor allocation

5.1. Current progress

ImpactA's progress has met the founder institutions' expectations in four stages as shown in figure 4: SGB invitation and selection, diagnosis, mentorship structure and service provision. Nevertheless, lessons learned from the invitation and selection process shed light on the necessity of increasing the initial deal flow by allowing other possible allies to submit candidates, rather than generating deal flow from founder organizations only. Moreover, from the selection point of view, it has been identified that a pre-selection committee involving mentors should be established. Selection criteria should be refined to avoid large discrepancies amongst the stages selected companies are currently at, and implement a test for the entrepreneur's willingness to receive coaching.

Regarding the mentorship structure, a necessity of carefully specifying the roles of senior and junior mentors has been spotted; mentor allocation based on experience is necessary to guarantee an adequate service provision dynamic and avoid conflicting or misinformed recommendations. Consequently, ImpactA's methodology document contemplates the inclusion of feedback given by both mentors and entrepreneurs about the process in all the procedures involved in the acceleration program.

From an operational point of view, each selected SGB prioritized two main topics to focus on during the program out of the critical ones identified in the diagnosis sessions. Specific goals for each topic were set by each company, allowing the coordinator to easily monitor the acceleration process' progress and establish measures of success for the program. In addition to the two priority topics defined for each SGB, financial and corporate governance topics where identified as general weaknesses for all businesses. For this reason, specific consultants and planned workshops have been defined as compulsory activities in order to address these weaknesses and strengthen the entrepreneurs' competencies.

Most of the SGBs signed in ImpactA have undertaken important strategic and organizational restructuring processes. This has led them to better understand their business models, and therefore enhance their value offer for clients, and even broaden their market opportunities. These actions also evidence an adoption of rigorous planning practices in terms of processes and human capital leading to the identification of financial inefficiencies and better retention strategies for human capital.

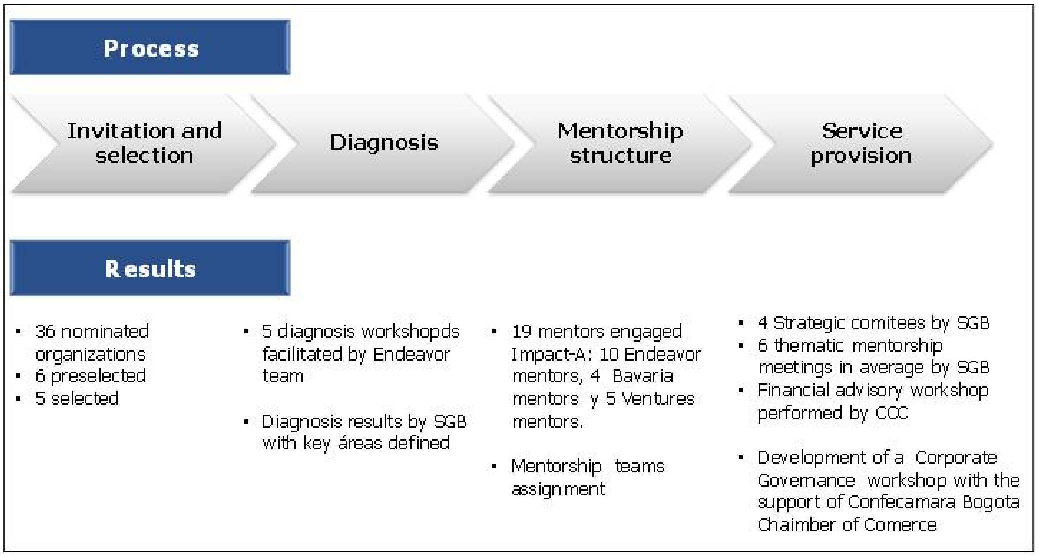

Fig 4. General results of the process

Nevertheless, interesting strategic and operational insights have derived from ImpactA's activities that are worth mentioning. In terms of articulation strategy, team-work has led each founder organization to better define the type of client it is addressing as well as the services it is willing and able to provide beyond ImpactA. This, to guarantee entrepreneurs are receiving differentiated services from the founder institutions. Furthermore, the close interaction that some of the founder institutions hold with government (figure 5) has led to multiple meetings with senior public officials both in the local and national levels (City Hall and Minister of Commerce), opening the door to the public sector as an ally in ImpactA and a possible sponsor during coming versions of the project. Government involvement is expected to tackle the bottlenecks that have been identified in the ecosystem and previously explained, that policies and public programs have not yet been able to solve.

ImpactA will also carry out a strategic planning process before the culmination of the current program, September 2012. It will take place in three steps: a first step of individual evaluation of the current achievements of the project, a second step which will be workshop with all of the representatives of the six founding organizations, and a third step in which the key elements of discussion will be presented to the board.

Upon culmination of the program, lessons learned and possible improvements will be incorporated into the model in order to perform the first official version, including other players that have manifested an increasing interest to be involved. Furthermore, this implies that the government will have to play a key role in the propagation of ImpactA's successes.

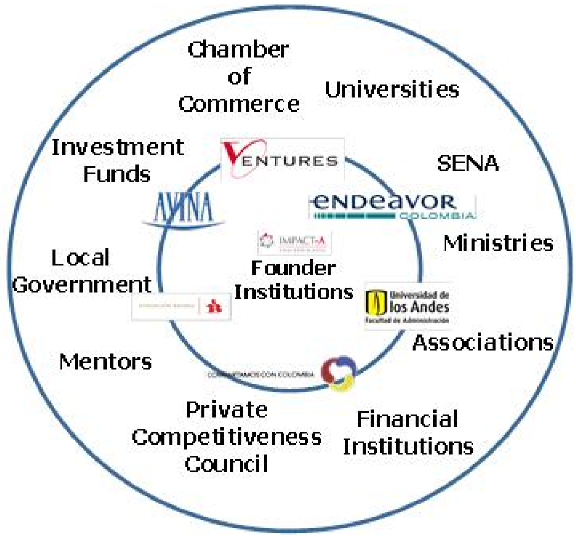

Fig 5. Extended Triple Helix Platform surrounding Founder Institutions

6. How the project fits the Triple Helix Model

The Triple Helix model first mentioned by Etzkowitz and Leydesdorff (Leydesdorff and Etzkowitz, 1996, 1998) stated the existence of three spheres that interacted; university, government and industry. One of the statements mentioned was that an increase of interactions among institutions has the effect of generating new structures within each of them as well as to the creation of integrating mechanisms among the spheres in the form of hybrid organizations (Leydesdorff and Etzkowitz, 1996). In this sense ImpactA is a hybrid organization derived from the close interaction of two spheres, academia and industry that consequently reached the third sphere to consolidate the growth potential of the model. The emergence of interactions between university-industry and government are considered a key factor for the project as well as for the regional development (Etzkowitz, H. et al., 2005).

ImpactA's founding institutions share a common long term vision of generating wealth creation and prosperity for the region as they believe a collective multiactor approach surpasses the scope of individual efforts. This is the reflection of the Triple Helix Model: "wealth creation can occur through the knowledge produced by institutional arrangements between 'organizers' knowledge, such as universities, industries and government agencies"(Mello, 2004, p.2).

Ferreira and Mello(2010, 2004) state that the Triple Helix model establishes the relationships between the three types of actors and their respective spheres and puts the dynamics of innovation in a changing situation, in which they emerge and coexist with new and intricate relationships between these three institutional spheres. In this sense ImpactA is the development of knowledge through an arrangement of six institutions that incorporate industries and universities and the fore-coming government, leading to an innovating tailor made acceleration process with tangible results from the SGBs that have served and will serve as examples for other local public and private programs. The generation of this accelerating process that incorporates best practices of founding organizations and a clear identification of government weaknesses, has the potential to be replicated nationwide, contributing to the solution of one of the main concerns of the entrepreneurship ecosystem in Bogotá.

Almeida (2004, p.3) states as mentioned by Ferreira et. al (2010) that "The Triple Helix model points out four levels of transformations between institutions in each sphere: internal changes in the role of each; influences of the institutions of a sphere over the other as a result of existing relationships, creation of new structures due to the overlap caused by the interaction of three helices, and finally, the recursive effect of these three levels on the majority of social institutions such as the science itself". ImpactA has evidenced three of the transformation levels mentioned by Almeida; on the first hand the construction of a particular role of each institution within the project has made the six organizations adapt their capacities to fit the project's needs, leading to internal changes in each. Second, the enforcement of an existing relationship has created an impact in the way all organizations work, influencing the approach they all have towards entrepreneurship at all levels. Third, as a result of the project, a new structure has been created as shown in figure 5, in which the government is a key actor that operates on a second level sphere.

ImpactA with its short and long term objectives fits the collaboration and innovation approach derived from the triple helix model, as it has been conceived to involve academia and private sector in the short run and government as key actors. This initiative will serve as a role model for the promotion of a collaborative approach to the development of the entrepreneurial ecosystem in a developing country with increasing inequality and high rates of poverty but an increasing investment potential. The conceptualization of the initiative emerged from the identification of needs of the entrepreneurial ecosystem, and was then transformed to a reality catalyzed by the commitment, alignment, knowledge and communication of the founding members.

Colombia's SGB sector will be able to nominate and effectively select the best innovative SGBs with the ImpactA's selection process, which will culminate in their preparation to engage with potential investors. As a result, there will be a great advance in the practices, impacts and support of Colombia's SGB sector and therefore an impact in the economy as a result of the triple Helix synergies.

7. Conclusions

ImpactA with its short and long term objectives fits the collaboration and innovation approach derived from the Triple Helix as it has been conceived to involve academia and private sector in the short run and government. This initiative will serve as a role model to foster a collaborative approach that will enhance the dynamics of the entrepreneurial ecosystem in a developing country with increasing inequality (Gini 0.56) and high rates of poverty (37% under poverty line) evidenced by the Private Competitive Council. The transformation of a concept model into a successful program has proven that the inter-organizational relationships result in an interesting innovative model, as it contributes to the cohesion of the ecosystem as a mechanism for wealth creation in the region. The interactions held with government have helped to identify key bottlenecks to be addressed and the potential of escalation the project has in the national level as a knowledge transfer mechanism and as a key operator. The execution has brought interesting lessons regarding the needs and services provided to entrepreneurs. These lessons have generated an impact on the evolution of the program as well as within the founding organizations as expected by a Triple Helix model.

As a result, there will be a great advance in the practices, impacts and support of Colombia's SGB sector and therefore an impact in the economy as a result of the Triple Helix synergies.

7.1. Further Studies and policy implications

There is a need to further investigate the adaptations and results these types of programs may have among the different regions and therefore the differentiated impacts they may generate. Furthermore, a comparison among international vs local adapted programs that address the same community may also be an interesting element of study.

On the other hand, understanding whether an acceleration program should charge entrepreneurs a small portion of their company's equity or not can lead to interesting hypotheses regarding the funding structures of these types of initiatives. The study of successful equity oriented accelerators will provide insights for the government and the academia on how they can create incentives for the generation of effective high quality programs, catalyzing the development of the entrepreneurial ecosystem.

Our study generates several implications for local and national government entrepreneurship directors. First, it will generate guidelines for effectively identifying and addressing entrepreneurs' needs, enabling better government support programs. Second, it may drive policy makers to enhance inter-organizational work to foster collaboration as a key driver of innovation.

Acknowledgements

These and the Reference headings are in bold but have no numbers. Text below continues as normal.

References

Angel Capital Association, (2012). ACA Summit 2012, Austin, Texas, 5-8 of March 2012. Available at: www.aca.org

Almeida, M., (2004). Incubadoras, parques tecnológicos e inclusión social en Brasil. In: Análisis del IX Congreso Internacional de CLAD sobre la reforma del Estado y la administración pública, Madrid, Spain, 2 - 5 Nov. 2004. Retrieved 2011 from
www.iij.derecho.ucr.ac.cr/archivos/documentacion/.../almeida.pdf

Bancoldex and Ministerio de Comercio Industria y Turismo, (2010). Catálogo Fondos de Capital Privado en Colombia. Grupo Salmántica, p. 23-17

Etzkowitz, H. and Klofsten, M., (2005). The Innovating Region: toward a theory of knowledge-based regional development. R&D Management, 35 (3), 243-255.z

Leydesdorff, L.; Eztkowitz, H.,(1996). Emergence of a Triple Helix of University-Industry-Government Relations. Science and Public Policy, vol XXIII, 279-86.

Ferreira, N. A., (2004). The role of UFSC and the creation of Technological Innovation Park in Joinville and Region1. In: Anais do II Seminário Internacional Empreendedorismo, Pequenas e Médias Empresas e Desenvolvimento Local Rio de Janeiro, RJ, Brasil 2-4 of august 2004. Retrieved 2011from www.itoi.ufrj.br

5th Global GEM Research Conference Entrepreneurship Monitor Presentation, Cartagena, Colombia, 6-8 october of 2011 Retrieved 2011 from: http:// www.gemconsortium.org

Guerrero A., Vezga R., Montenegro A. et al., (2011) Hacia un ecosistema de emprendimiento en Bogotá, Bogotá Octubre de 2010. Bogotá, Colombia: Universidad de Los Andes Facultad de Administración y Alcaldía Mayor de Bogotá.

Mello, J. M. C. (2004) A abordagem Hélice Tríplice e o desenvolvimento regional. In: Anais do II Seminário Internacional Empreendedorismo, Pequenas e Médias Empresas e
Desenvolvimento Local Rio de Janeiro, Rio de Janeiro, Brasil 2-4 of august of 2004.
Retrieved 2011 from www.itoi.ufrj.br

Private Competitiveness Council, (2011). Informe Nacional de Competitividad 2011-2012, Estudio de competitividad, Editorial Norma, p 242

Salazar, A., (2011). Escalando el emprendimiento en Colombia: La voz de los emprendedores, The Breakthrough & Monitor Group, p 34-37. Retrieved 2012 from: http://goo.gl/jV5uH

THE DEVELOPMENT OF INNOVATION IN THE ODONTOLOGY FIELD IN BRAZIL

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Abstract
Innovation has been viewed as the key element in economic and social development, providing a special opportunity for developing countries within a globalized economy. Important transformations began to take place in the`70s and`80s, with the development and commercial exploitation of innovations in the fields of microelectronics and information technology, telecommunications and new materials, as well as appreciation of the future importance of innovations in the biosciences, which definitively consolidated the role of scientific research and its natural location - the university - in social and economic development (Kim and Nelson, 2005; Etzkowitz and Leydesdorf, 2000). The triple helix, which was also used as a point of reference for this work, is a conceptual model that suggests there is a new dynamic in the relations between university, business and government and in the participation of each one in actions to foster innovation, using scientific research to generate new knowledge and technology (Etzkowitz, 2008).
This paper aims to analyze, using the triple-helix model, the development of innovation in the health field; specifically, odontology in Brazil. This is an exploratory study, considering the limited scientific output on the subject within the academic sphere, in regard to the odontological equipment and materials industry.
Study of the development of innovation in the odontological equipment and materials industry shall be confined, within the scope of this paper, to analysis of the universities and research institutes that are funded with resources from FINEP (Funding Agency for Studies and Projects), an institution with links to the Ministry of Science, Technology and Innovation.

Keywords: Innovation, odontology, triple helix

1. Introduction

Innovation has been viewed as the key element in economic and social development, providing a special opportunity for developing countries within a globalized economy. In the field of health, technological innovation can offer improvements in living conditions for the public, in addition to earning revenue.

The industry for medical and hospital materials and equipment in Brazil came into being in the 1950's with the production of materials for consumption such as needles, syringes and anesthesia devices, and the first factories for surgical instruments emerged in the following decade with the establishment of the industry for x-rays and film, laboratory instruments, electro-medical and monitoring equipment, pacemakers and heart valves. Industrialization via import substitution characterized this period, which reached its apex in the 1970's, and was very dynamic in terms of supply, presenting high rates of growth into the 1980's. In the 1990's this model came to an end with the commercial opening up of Brazil and competition with imported products. During this period imports have grown much more than exports for this sector, and there has been a need for a change of strategic posture, seeking specialization and international activities in niche markets, a model that is the opposite of import substitution, in which diversified companies geared towards serving the domestic market prevailed.

The industry for dental materials and equipment stands apart from the sector as a whole in several respects. The Brazilian dental device industry arose in the 1940's in RibeirãoPreto, SP, prior to the medical industrialization of the country. Whereas the government had played a fundamental part in the development of the medical-hospital sector throughout the 20th century, supporting and financing the expansion in the demand for medical services and industrial products associated with the sector, in dentistry practice, the predominant model was one of private services and scarce coverage fore the general population, provided by private dentists and characterized by the absence of the state in this sector. The equipment sector starts the 21st century with participation from the private, public and export sectors, with commercialization channels on the order of 70%, 20% and 10% (ABIMO, 2007).

Another characteristic of this sector is that, until 2002, it emphasized the production of odontological equipment. Companies not only supplied the domestic market, but also showed a significant export surplus in relation to a large number of countries, while the public sector played a small part in the commercialization of these products. The difference in the development of these two sectors can be explained by the fact that the equipment companies have used national inputs of a low technological level almost exclusively, whereas for the production of consumables, most of the inputs are imported (Manfredini and Botazzo, 2006; IEMI, 2009; Gutierez and Alexandre, 2004).

Another possible explanation of the disparity between the two segments (equipment and materials) is that equipment is usually produced for the purpose of setting up a dentist's office. With regard to materials, a characteristic of the Brazilian market is that domestic sales are carried out through companies stocking odontological articles, which sell them to the end consumer. These companies have significant influence over business strategies and innovation, since they represent the interface between suppliers and consumers (Lorenzo and Mancini, 2007).

The odontological sector encompasses equipment, instruments and materials used in odontological practice, whose main constituents are as follows: equipment: dentist chairs, gear, reflectors, X-ray equipment, stools, doses, and amalgam mixers, etc.; instruments: canisters, tweezers, scissors etc.; and consumables: resins, amalgams, waxes, cements for fillings, dental impression materials, etc. The National Register of Economic Activities (CadastroNacional de AtividadesEconômicas – CNAE) has classified this sector as one engaged in the manufacture of devices and instruments for medical-hospital, dental and laboratory use, as well as orthopedic devices; while the consumables group falls within the pharmaceutical sector (Manfredini and Botazzo, 2006; IBGE, 2011).

However, the field of odontological materials has not kept up with the development of the odontological equipment sector. One of the problems facing professionals in this area is the difficulty of obtaining good quality materials at an accessible price, since the vast majority is imported.

Moreover Brazil's domestic market needs to be taken into account, for according to the FDI, Brazil is the country with the largest number of dentists in the world, 19% of the world's dentists – in addition to being second only to the United States in the production and placement of dental implants.

According to Mancini and Lorenzo (2007) conditions are present to ensure the existence and evolution of processes of innovation, such as: an environment that allows companies to be integral parts of a system, a diversity and complementarity of competencies, and strong relationships with universities that are sources of innovation and cooperation among companies. Along these lines, the regions that are in a position to exploit the potential of resources, such as knowledge, experimentation, relationships, among other things, are the ones most likely to bring about the emergence and/or evolution of processes of innovation.

A survey carried out in 2010 by the Ministry of Health, involving 177 Brazilian urban centers, showed that among young people, tooth extractions are giving way to dental restoration, and there was no record of the need for a complete removable dental prosthesis in this age group. Among adults, although the need for dentures has been reduced by 70% since the last survey, in 2003, there was a need for some kind of prosthesis in 69% of cases, the majority (41%) being a partial prosthesis in one dental arch, while in 1.3% of the cases a complete prosthesis was necessary for at least one dental arch. Among the elderly (65 to 74 years old), 23% needed a complete prosthesis for at least one dental arch and 15% required complete double dentures, one for each arch. For this last group, the figures are very similar to those of the 2003 survey and account for more than 3 million elderly people who require a complete prosthesis for at least one dental arch and more than 4 million who need a partial prosthesis (Ministry of Health, 2010).

Given this demand, there is no justification for the lack of interest on the part of domestic industry in producing artificial teeth. One possible explanation of the disparity between the two segments (equipment and materials) is that the equipment is usually produced to order for the purpose of setting up a dentist's office. With regard to materials, a characteristic of the Brazilian market is that domestic sales are carried out through companies stocking odontological articles, which sell them to the end consumer. These companies have significant influence over business strategies and innovation, since they represent the interface between the suppliers and the consumers (Lorenzo and Mancini, 2007).

The passing of the Innovation Law, in 2004, which took effect in 2005, allowed the use of non-refundable government resources to stimulate innovation. Such resources may be invested in the development of products, processes or services that are considered to be innovative and thereby justify the State assuming part of the development risk. This led to the creation of programs to stimulate innovation, such as the Economic Subsidies, run by FINEP (Funding Agency for Studies and Projects) an institution with links to the Ministry of Science, Technology and Innovation.

Hence, companies working with odontological materials have found improved conditions for their development, leading to the generation of a number of innovations. Thus, the situation is slowly changing, and there are now several Brazilian companies that, in addition to manufacturing products in Brazil, have introduced some unique innovations. Since 2004, FINEP has provided more than US$ 20 million in financing for projects in the sector, ranging from the modernizing of laboratory infrastructure at universities to prize-winning innovations by companies.
In parallel, the analysis of how these innovations are taking place, what are the products being created, and what is the relationship that these companies maintain with universities and research centers allow for certain conclusions regarding innovation in Brazil's odontological industry.

In view of this new tendency towards the development of the odontological materials segment in Brazil, this paper proposes to conduct an exploratory study to analyze the projects supported by FINEP and their results, in order to form a clear picture of the development of innovation within the odontological equipment and materials sector.
This article is made up of four sections, including this introduction. Section two analyzes the state of the art, introducing the concepts of the triple helix model and an analysis of the odontology sector in Brazil. Section three exhibits the result of the analysis carried out in this survey. Section four presents conclusions and suggests alternatives for new research.

2. State of the art

The state of the art in this survey will be sub-divided into two sections. The first deals with the theoretical model of the triple helix, and the second with an analysis of the sector of odontological \equipment and materials in Brazil.

2.1) The Triple Helix

This item addresses the key concepts that explain the model of the triple helix. It emphasizes its main point: the growing role of academe in the production of technological innovation in a society based on knowledge.

Important transformations began to take place in the 70's and`80's with the development and commercial exploitation of innovations in the fields of microelectronics and information technology, telecommunications and new materials, as well as appreciation of the future importance of innovations in the biosciences, which definitively consolidated the role of scientific research and its natural location - the University - in social and economic development (Kim and Nelson, 2005; Etzkowitz and Leydesdorf, 2000).

The triple helix, which was also used as a point of reference for this work, is a conceptual model that suggests there is a new dynamic in the relations between the three spheres – university, industry and government - and in the participation of each one in actions to foster innovation, using scientific research to generate new knowledge and technology (Etzkowitz, 2008).

The principle by which the triple helix is organized is the expectation that the university has a major role to play in society, the so-called “third mission," such that, beyond instruction and research, it comes to contribute to economic development.

The concept of the triple helix explains these new and complex inter-institutional relationships, where innovation emerges from this ongoing process of exchange in each of the three spheres. Whenever institutional overlap is achieved culturally, there emerges an environment to allow an interaction among institutions will produce results, in terms of innovation strategies. The emergence of this new entity – the triple helix – thus constitutes a new synthesis between the university, business and government (Etzkowitz and Leydesdorff, 1998, 2000).

The analysis of the interaction between academe, business and government has been expanded as a result of the introduction of a new concept, Triple Helix Spaces: Knowledge, Innovation and Consensus Spaces, which examines the processes and mechanisms whereby institutional spheres interact and are modified over the course of time. This approach assumes that interaction takes place in a given period of time (a synchronic interaction). This makes it possible to analyze the transition of configurations of the triple helix over the course of time, through an analysis of their interactions (a diachronic interaction) (Etzkowitz and Ranga, 2010).

2.2) Odontology and the creation of new products

Brazil's odontology industry is a recent phenomenon, and still quite dependent on products from the United States, Europe and Japan. Because of this, in the domestic market the biggest competitors are imports. For companies wishing to export, the main barrier is still prejudice, since what is involved is a company from a country with no track record of research and development in the field. “Although it is an impediment, we are patiently breaking down barriers and winning space,” explains Roberto Alcantara, the director of Angelus[6], a company created in an incubator.

For example, in a survey of commercial brands of artificial teeth available in the Brazilian market, it was noted that the various commercial brands were produced by a limited number of companies, the majority of which were foreign owned. Only two Brazilian manufacturers of artificial teeth were identified, both of which were located in the town of Pirassununga in the state of São Paulo. Among the foreign commercial brands, only one is manufactured in Brazil (Dentsply – Petrópolis/RJ), while the others enter the country through importers or local subsidiaries for Brazilian distribution, with ensuing problems associated with customer care, cost and dependence on foreign suppliers.

In spite of this, in 2011, the city of Pirassununga achieved a volume of exports equivalent to US$ 51,126,143.00, with artificial acrylic teeth ranking in fourth place, with billing of US$ 1,789,493, 3.5% of total exports (Ministry of Development, Industry and Commerce, 2011).

According to the Brazilian Association of the Industry for Medical, Dental, Hospital and Laboratory Equipment (ABIMO – AssociaçãoBrasileira da Indústria de EquipamentosMédicos, Odontológicos, Hospitalares e de Laboratórios), the Brazilian dental market is the only segment that has presented a trade surplus for more than ten years; in 2011, the dental sector that comprises part of Brazil's health industry exported US$ 87 million, and imported US$ 80 million.

In the ranking of countries that purchase most Brazilian products are the following: Germany, the United States and Venezuela. Among items exported, the most sales were for odontologicalinstruments and devices, dental chairs, artificial acrylic teeth, X-ray devices, drills and other products for dental obturation.

Particularly noteworthy among Brazilian companies in the odontological sector are the following: Angelus, Baumer, Bioeart, Biodinâmica, Conexão, DabiAtlante, Dental Morelli, Dentflex, DMC, Driller, Erwin Guth, Essence Dental, Fami, Gnatus, Hi Technologies, Indusbello, Loktal, Maquira, Microdont, MM Optics, Odontocase, Olsen, Q2Tec, Quinelato, Sercon, TDV, VIPI and X Dent. Among these companies, two subsidized by FINEP should be pointed out: Angelus and DabiAtlante.

An APL (Local Production Arrangement) is characterized by a geographical and sectoral concentration, generally of small and medium-sized companies that have a systematic relationship among themselves, which enables them to become more competitive. This relationship involves articulation, cooperation and learning, not only among the companies themselves, but with other local actors, such as educational and research institutions, business associations and government.

In the region of RibeirãoPreto, according to data of the Secretary of Development for the State of São Paulo, there are 69 companies in the EMHO sector, most of them micro-, small and medium-sized firms. They employ more than two thousand people and make the city a model of production and technology in the health sector. Ribeirão has the greatest per capita concentration of businesses in this sector in all of Brazil. In absolute numbers, it ranks fifth.

Since this is a sector with a powerful innovative and strategic dynamic, not only for the municipality but for Brazil as a whole, a variety of institutions within the municipality are organized in accordance with the perspective of Triple Helix Spaces: Knowledge, Innovation and Consensus Spaces (Etzkowitz and Ranga, 2010). The knowledge space is comprised of the Universidade de São Paulo (USP), RibeirãoPreto campus; the innovation space is made up of the locally established companies, the incubator and the incubated companies; and the consensus space by the set of institutions comprising the Advanced Health Pole Foundation Institute of RibeirãoPreto (FIPASE – FundaçãoInstitutoPóloAvançado da Saude de RibeirãoPreto) which act together to further the development of the odontological equipment and products industry, notably

[6] http://www.angelus.ind.br/midia.asp?cod=170; accessed on January 23, 2012.

by taking part in fairs and promoting consultancies and managerial and technological training courses[7].The business incubator in the municipality (SUPERA – Technological Incubator of RibeirãoPreto), was created through a partnership among several institutions, such as Sebrae-SP, Fipase, local government and USP[8] as an action within the consensus space.

At present, Brazil has 101 companies manufacturing dental articles and equipment, with more than 70% of these units based in the region of the State of São Paulo. More than 56% of the firms comprising this sector are vigorously competing in other markets outside Brazil. As of now, the Brazilian health industry exports to 180 countries on five continents. For the past 10 years, the partnership between Apex-Brasil and Abimo has been fostering the promotion of exports in the sector for medical, dental, hospital and laboratory equipment, and during this period there has been annual growth of 10%, with the exception of 2009. The odontology segment is the most outstanding of all that make up Brazil's health industry, since it is the only sector to exhibit a surplus in the balance of trade. In 2011, the positive balance was approximately US$ 7 million, with dental chairs and devices contributing to this figure, along with artificial teeth, while the items that are most heavily imported are materials for fillings, instruments and devices as well as dental prostheses. Today, Brazil has 101 companies manufacturing odontological articles and equipment, and more than 70% of these units are based in the region of the State of São Paulo[9].

The triple helix, which was also used as a point of reference for this work, is a conceptual model that suggests there is a new dynamic in the relations between academe, business and government, and in the participation of each one in actions to foster innovation, using scientific research to generate new knowledge and technology (Etzkowitz, 2008).

3. Methodology

The method used has been one of exploratory studies, whereby the companies subsidized by FINEP from 2006 to 2010 were analyzed, seeking to establish a suitable analytic framework in order to discover company dynamics and identify the role of the institutional environment in the companies' process of innovation, that is, the generation, absorption and diffusion of new technology. Beyond this, it is hoped to achieve an understanding of the various models of productive activity at these firms.

The data collected at the FINEP site have been used as a primary source for the selection of companies that have been the focus of this study. The search was conducted by product or by company known to operate in the dental field. The data collected at the FINEP site were compiled on the basis of the year of subsidy, company size, volume of resources, areas of development, patent registration, etc.

The gathering of data from secondary sources was carried out through interviews with company managers and representatives, using question based on earlier information. In addition, use was made of the information obtained from marketing documents produced by the companies themselves and posted on their own sites. Other sources for gathering data on patent registrations in Brazil were obtained from searches in the patent database of the National Institute of Industrial Property (INPI – InstitutoNacional de Propriedade Industrial).

4. Findings and interpretation

Since this article seeks to analyze new trends in the development of the odontological equipment and materials segment in Brazil based on projects approved in FINEP calls for tenders, one first issue to touch upon is the Economic Subsidy Program. This program was created by the federal government and is intended to stimulate activities of innovation and increase the competitiveness of companies' innovative products, processes and services, aiming towards the development of areas considered strategic in federal public policy[10].

Based on a public selection process, it grants financial support to companies in the form of unreimbursable public funding, and in this way shares with the companies the costs and risks inherent to such activities.
The funding made available for the Economic Subsidy Program is provided by sectoral funds established in 1997, whose purpose it is to ensure sources of public funding to finance the growth of activities in the field of Science & Technology (C&T). Revenues for funding come from contributions accruing from the results of the exploitation of natural resources

[7]http://www.fipase.org.br/index.php?option=com_content&view=article&id=66&Itemid=48; accessed on March 12, 2012.
[8]http://www.fipase.org.br/index.php?option=com_content&view=article&id=46:642010superaribeiraopretobiotecnologia&catid=10:noticias&Itemid=7; accessed on April 23, 2012.
[9]http://www.abimo.org.br/modules/news/article.php?storyid=265 acesso em 20/03/2012.
[10] www.finep.gov.br/programas/subvencao_economica.asp accessed on January, 23, 2012.

belonging to the Federal government, portions of the Tax on Industrialized Products (IPI) from certain sectors, and the Contribution for Intervention in the Economic Domain (CIDE) collected on amounts that pay for the use or acquisition of technological knowledge/technology transfers from abroad.

The Economic Subsidy Program commenced in 2006, which constituted the first time that an instrument of this kind was made available in Brazil. There have already been five calls for tenders for economic grants, in 2006, 2007, 2008, 2009 and 2010. During this period, 500 companies have received support for a total of 695 projects. The Health field, with 98 projects approved, representing 14% of the total, is in second place. Of these 98 projects, 36 were considered of interest in the field of odontology (approximately 5.2%). To determine this amount, projects were selected originating at companies in the dental sector or projects by companies in other sectors, whose final products were strictly for odontological application (i.e., mouth rinses, materials for fillings) or projects for multidisciplinary products (magnetic resonance devices, bone substitutes, etc.).

Analysis of the data on companies with projects approved in the five editions of the program was conducted based on the following elements: geographic distribution, subsidy year, company size, Subjects of Interest in Calls for Tenders, project purpose (equipment and materials), and innovative products, patents and relationships with universities.

4.1. Distribution by State, Call for Tender Year, Company Size and Funding

The geographic distribution of the companies supported by the Economic Subsidy Program from 2006 to 2010 for projects of odontological interest is shown in Table 1, below.

Table 1 – Distribution of companies by state

Region	State	Nº Companies
Southeast	Rio de Janeiro	3
	São Paulo	12
	Minas Gerais	4
South	Santa Catarina	1
	Paraná	4
	Total companies	24

Source: The authors, based on data released by FINEP.

It is observed that the location of the companies is strongly associated with the Southeast region of Brazil, considering that 19 companies, equivalent to 79% of the total, are concentrated there. This tendency was also noted in the study done by FIPASE, 2007 which related this result to the ease of shipping out production, the high concentration of university centers, the consumer market and ease of hiring skilled labor in this part of the country. Companies in this sector are located chiefly in the state of São Paulo (50%) due to the presence of the two municipal poles of RibeirãoPreto (equipment) and Araraquara (materials).Table 2, below, shows the distribution of companies whose projects are of odontological interest, broken down by year of call for tender, size[11], number of projects and funding approved for the years 2007 to 2010.

Table 2 - Projects Approved by company size and distribution of funds

Year	Size of Business	Nº Projects	Funds (U$)	Funds per year (U$)
2007	ME/Small	7	6.271.631,65	6.271.631,65
2008	ME/Small	8	10.014.390,60	12.297.080,93
	Large	1	2.282.690,33	
2009	ME/Small	7	8.198.166,98	10.657.322,50
	Medium	1	1.001.300,00	
	Large	1	1.457.855,52	
2010	ME/Small	5	7.641.530,93	13.889.308,13
	Medium	1	6.247.777,20	
Total projects approved		31	Total funding	43.115.343,21

Source: The authors, based on information from FINEP calls for tender, 2007 to 2010

[11]FINEP classifies the size of companies by their billing: Micro-Enterprise (ME)/Small Business – up to US$ 1,273,344; Small – from U$ 1,273,344 to U$ 5,569,405.4; Medium-sized – U$ 5,569,405.4 to U$31,825,173; and Large, upwards of U$31,825,173.

From 2007 to 2008, the amount made available to companies with projects for this sector practically doubled, while showing a slight drop in 2009 and holding steady in 2010. Of the total amount of funding approved, it is observed that 91.32% was allocated to micro-enterprises (ME) and small businesses. It should be noted that the data for 2006 is not included here, since the data released on projects approved by FINEP did not contain information on the amounts allocated to each individual company.

According to ABIMO (2007) this is the profile of companies in Brazil, consisting mainly of small and medium-sized businesses (81.1%) and with national capital (97%). They are characterized by low technological content in order to avoid direct competition with foreign suppliers, despite the fact that national products do have the necessary quality to compete with U.S. and European products. The companies studied in this survey are an exception to this pattern, as it is observed that there is a new trend for micro- and small business to undertake R&D, increasing the technological content of their products that will probably enter into competition with imported products.

Of the 24 companies considered, only 6 are companies from the dental sector, and they exhibited a total of 15 projects, with a rate of 2.5 projects per company. The remaining 18 companies from other productive sectors accounted for 21 projects, which represents an average of 1.2 projects per company. This result suggests certain dynamism on the part of odontological companies in comparison with others in the EMHO sector.

4.2. Purpose of company projects

In the calls for tender of the Economic Subsidy Program (2006 to 2010), the subjects proposed by FINEP encompass a broad range of possibilities and underwent significant alterations over the course of this period, becoming increasingly specific. It is noted that in the calls for tenders for 2006 and 2007 project areas were not clearly defined, and only starting with the 2008 call for tender is this concern noted on the part of the financing agency. In 2006, the areas presented were: General subjects, Technological condensation of the aerospace chain; Pharmaceuticals and medications, Biomass/alternative energy, Nanotechnology, Biotechnology, Semiconductors and Software – Digital TV, Capital goods: focus on the productive chain for biofuels and solid fuels, Software – mobilizing and strategic applications. In 2007, the following subjects were addressed: IT, communications and nanotechnology; Biodiversity, biotechnology and health; Innovation in strategic programs; Innovation in the fields of biodiversity and energy, and Innovation for social development. Starting in 2008, six key fields were identified, which also served as a theme for the subsidies of 2009 and 2010: Information and communications technologies; Biotechnology; Health; National Defense; Energy and Social development.

In 2006, five projects of odontological interest were approved in two areas of the call for tenders: General Subjects (3) and Nanotechnology (2). In 2007, there were seven projects in three areas: IT and communications and nanotechnology (4), Innovation in the fields of biodiversity and energy (2) and Innovation for social development (1). In 2008, nine projects were approved in three areas: Biotechnology (3), Health (5), and Strategic programs (1). In 2009 and 2010, nine and six projects were approved, respectively, all in the field of health, regardless of the subject addressed in the project. This change of classification would prevent a project to develop a nanostructured material for fillings in natural teeth, for example, from being removed from the health field and reclassified under nanotechnology as had occurred previously. If, on one hand, this classification simplified the selection process and the distribution of funding to specific sectors such as health, on the other hand, the way in which the subjects are presented prevents us from knowing to what sub-field the funding is being directed, and also, which ones are truly innovative activities, and which ones are modernization activities.The breakdown of such information and the specific technical knowledge required for each project is essential for the selection of projects of varying levels of technological complexity.

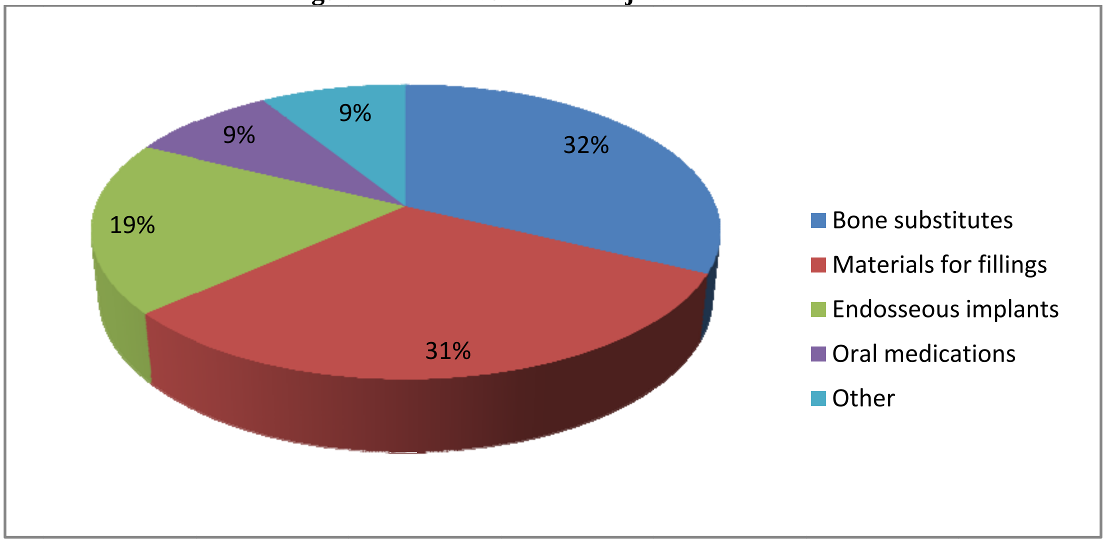
In the specific instance of projects of odontological interest, in the absence of normative parameters for the classification and understanding of the type of project approved, in addition to grouping companies in two broad areas of materials and equipment, other subdivisions based on project type were defined.

In order to conduct this analysis for the field of materials, company projects were classified according to the main categories of materials used in the odontological area, notably: Materials for fillings (for replacement of dental tissue), Endosseous implants(titanium dental implants), Oral medications (rinses), Bone substitutes(materials for grafts) and Others.

In the field of equipment, projects were classified as: Gear (chairs, suction pumps, etc.), Quality (gear for quality control of already existing equipment), IT software (management systems, etc.) and Images (x-ray, magnetic resonance, etc.).

With respect to these two major categories, materials and equipment, one initial point is to be noted concerning the number of projects and the distribution of funding. It is observed that the materials category exhibits a greater number of projects and more funding, with 24 projects and 75.51% of the funds, as opposed to 12 projects and 25% of the funds for the equipment category. Figure 1 below shows the breakdown of materials projects approved by product category.

Figure 1 – Distribution of Projects in Materials



Source: The authors, based on FINEP data.

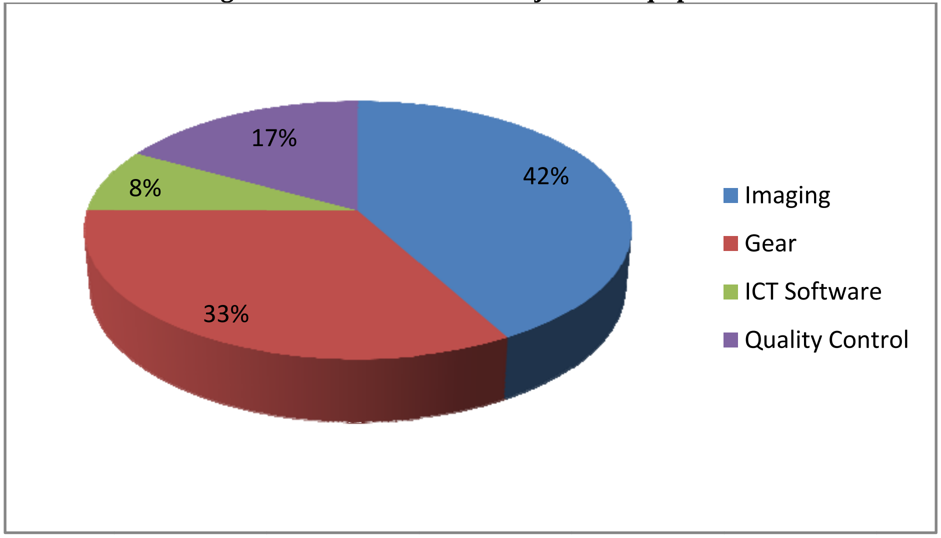
Most of the projects are concerned with the development of bone substitutes (38%). This is a sector encompassing a wide area, which serves the demands of the orthopedics sector, bucomaxillofacial surgery and periodontics.

In addition, it is an area with great growth potential in Brazil, because there is internalized technological capacity. Brazilian companies compete with imported products, products of animal origin and bone banks. The scientific development of this field falls short of what is desired, due to the difficulty of making biological properties compatible with mechanical requirements. As a result, there is a space for Brazilian groups to do research and innovate (Soares, 2005). Another advantage exhibited by Brazil is the possibility of carrying out tests on live subjects (as long as it is duly approved by National Committee for Ethics in Research, an essential stage for rendering viable the development of a product/process, and whose use is considerably restricted in the countries of the industrialized world.

Another area for project development by companies supported by the calls for tender noted above is in endosseous implants(17%), which represent an area of incremental innovation, and although the titanium used is imported, the entire production line is implemented in Brazil. It should also be pointed out that of the total of 24 projects approved in the materials category, eight are in nanotechnology, five for the development of implants and materials for fillings (28%), with greater added value.

The breakdown of company projects approved in all editions of the program in the equipment field can be seen in Figure 2, below.

Figure 2 – Distribution of Projects in Equipment



Source: The authors, based on FINEP data.

The analysis of the projects presented shows a direct relation to the market for products in this area. Thus, technology for the production of equipment for consulting offices has already been developed in Brazil and requires a low level of technological innovation, despite the constant improvements they exhibit. 33% of the projects in the gear category were for the development of accessories, for the purpose of developing surgical equipment and sensors. The area with a technological dependency on imported equipment is concentrated in the field of dental radiography, with (42%) of the projects. Accordingly, these projects are intended for the development of equipment which Brazil is lacking, as well as improvement in product quality (17%). The software proposed is intended for diagnostics and management of dental consulting offices. According to Fipasa (2007), in 2006 Brazil imported from the U.S. three key products, medical-surgical or dental non-electric instruments, physical instruments and X-ray devices. These three products added up to nearly US$ 465.4 thousand, which accounts for roughly 50% of the list of exports of the United States' EMHOsector to Brazil.

With regard to equipment production, the more complex and expensive equipment, such as diagnostic imaging devices and certain laboratory devices, was not included in the policy of import substitution. This is due to the protected market policy for computers introduced in the 1980's, because it chased away multinational companies that were established in Brazil. Even with the end of the protected market in the 1990's, multinational companies were not interested in producing them domestically (Furtado and Souza, 2000). Thus it can be seen that there is a market space in which small businesses can undertake to develop equipment. In this case, four companies are engaged in this activity: Fit, Safesoft, Serve and Sky, two of them having a relationship to business incubators (Fit and Sky).

4.3. Patent Registration

Of the 24 companies with approved projects (36 projects), 15 of them (66.66%) have patents registered in Brazil, 13 of the companies responsible for 23 of the projects (x%) are microenterprises or small businesses, two companies are medium-sized and one is large, accounting for three projects. Of the total funding approved for projects of odontological interest in the period from 2007 to 2010, (69%) were for projects by companies with patents. Of the 15 companies with patent registrations, 13 companies have more than one application, and among these, five made their patent deposit after receiving the subsidy: one application has already been granted (application filed in 2008), two are awaiting administrative decisions (applications filed in 2009 and 2011) and two applications were rejected (applications filed in 2005 and 2006). Of the 15 companies with patent registrations**,** seven have projects in the field of equipment, six in the field of materials and one company presented projects in both fields. The nine companies that do not have patent registrations and even after receiving the subsidy they did not apply for patents. These companies received subsidies in 2007 (one company), 2008 (three companies), 2009 (three companies) and 2010 (two companies).

It should also be noted that in the process of contracting the 24 companies, 14 already had patent registrations, and after the subsidy only one of the companies that did not have a registered patent filed an application for one. Although the Economic

Subsidy Program is an unprecedented initiative in Brazil, it prompted a variety of impressions and opinions on its application, efficiency and effectiveness. According to FINEP, this is indeed an unprecedented initiative for Brazil, and it will only be possible to evaluate it consistently after the projects are concluded, and more specifically, two or three years after the products, processes and services developed have entered the market.(FINEP, 2010)

4.4. The University - Business relationship

The evaluation of the role of the three spheres of academe – business – government, in accordance with the proposed model for the triple helix, makes it possible to ascertain whether there is interaction between academe and businesses to develop the products indicated in the projects, as shown in Table 3.

The relationship of businesses with universities can be visualized in terms of three aspects: a) business as a research partner of the university; b) an incubated company or one associated with the incubator of a university; c) use of university laboratories for the execution of tests and trials.

	Company	Number and area of project	Relationship with the University
Materials	ACHÈ LABORTÓRIOS FARMACEUTICOS	Medication for oral use	Partnership with university.
	ANGELUS INDÚSTRIA DE PRODUTOS ODONTOLÓGICOS LTDA	Bone substitute Endosseous implants (1) Materials for fillings (2) Others/Packaging	Company graduated from Industrial Incubator of Nondrinker (INCIL), Paraná. Partnerships with the Faculty of Odontology of the Federal University of Pelotas (Rio Grande do Sul), with the Technological Research Institute of São Paulo, with the Federal University of São Carlos (SP) and with the Aerospace Center (SP).
	BIOACTIVE TECNOLOGIA EM POLÍMEROS	Bone substitutes	Company incubated at the Center for Innovation, Entrepreneurship and Technology (CIETEC), São Paulo. One of the partners is a DSc researcher of the Department of Metallurgical Engineering and Materials at USP.
	COM. IMP. PROD. MED. HOSP. PROSINTESE LTDA	Bone substitutes	-
	DENTSCARE LTDA	Materials for fillings (2) Others Medication for oral use	A company whose R&D manager is a Professor (PhD) at the University of Vale do Itajaí and the University of the Joinville Region (Santa Catarina)
	DNCER INDÚSTRIA E COMÉRCIO LTDA	Materials for fillings	One of the partners is a staff member at the National Institute of Technology.
	FGM PRODUTOS ODONTOLÓGICOS LTDA	Materials for fillings	A company whose R&D manager is a Professor (PhD) at the University of Vale do Itajaí and the University of the Joinville Region (Santa Catarina)
	GENIUS BIOTECNOLOGIA PESQUISA E DESENVOLVIMENTO LTDA	Bone substitutes (2)	Company incubated at the Center for Innovation, Entrepreneurship and Technology (CIETEC), São Paulo.
	JHS LABORATÓRIO QUÍMICO LTDA	Bone substitutes	Spin-off, a company incubated at the Biominas Foundation. Products derived from the Master's and Doctoral theses of two partners who are professors retired from the Federal University of Minas Gerais (UFMG).
	LABORATÓRIO BIOSINTESIS P&D DO BRASIL LTDA	Bone substitutes	Company incubated at the Center for Innovation, Entrepreneurship and Technology (CIETEC), São Paulo.
	NANOCORE BIOTECNOLOGIA LTDA	Endosseous implants	Company graduated from the Incubator Supera, RibeirãoPreto, São Paulo. One of the partners is a Professor (PhD), retired from the UFMG and was a visiting professor at USP. It has a partnership with Unicamp, Campinas, SP)
	SILVESTRE LABS QUÍMICA E FARMACÊUTICA LTDA	Bone substitutes (2)	Company do Parque Tecnológico da Bio Rio, Rio de Janeiro.
	SISTEMA DE IMPLANTES NACIONAIS E DE	Endosseous implants	One of the partners is a Professor (PhD) at the University Hospital of

	Company	Number and area of project	Relationship with the University
	PRÓTESE COM. LTDA		the University of São Paulo, SP
	VIGODENT S/A INDÚSTRIA E COMÉRCIO	Dental tissue replacement	The company was acquired by a multinational company in 2011. At the time that it executed the project it had a partnership with the Federal University of Santa Catarina.
E quipment	ACME EQUIPAMENTOS MÉDICO-ODONTOLÓGICOS LTDA	Equipment	-
	ANGELUS INDÚSTRIA DE PRODUTOS ODONTOLÓGICOS	Imaging	Noted above.
	ATCP DO BRASIL	Quality	CompanygraduatedfromParqtec, São Carlos-São Paulo.Partnership with the Microstructure Materials Engineering Group at the Federal University of São Carlos – UFSCar.
	DABI ATLANTE S/A INDÚSTRIAS MÉDICO ODONTOLÓGICA	Equipment	-
	FINDME MULTI SISTEMA DE RASTREAMENTO LTDA	IT software	-
	FIT - COM. IMP. EXP. DE MAQ. E EQUIP. ODONT. MED. HOSP. E LAB. LTDA	Imaging(2)	Company incubated at the Center for Entrepreneurial Innovation and Technology (CIETEC), São Paulo.
	ORTUS IND. E COM. LTDA	Equipment	Company graduated from the Incubator of the Educere Foundation, Campo Mourão, Paraná. Conducts research in partnership with the State University of Londrina, Paraná.
	SAFESOFT INDÚSTRIA E COMÉRCIO DE EQUIPAMENTOS ELETRÔNICOS LTDA	Imaging	-
	SERV IMAGEM MINAS SERVIÇOS, INDÚSTRIA E COMÉRCIO LTDA.	Imaging	-
	SKY TECHNOLOGY INDÚSTRIA E COMÉRCIO DE PROD. ELETRÔNICOS LTDA	Imaging	Company developing project with TNX-9, a company associated with one of the incubators at the Center for Competitiveness and Innovation of the Southern Cone, São José dos Campos, São Paulo.
	WELLE TECNOLOGIA LASER LTDA	Quality	Company incubated at the Entrepreneurial Center for the Development of Advanced Technology (CELTA), Federal University of Santa Catarina. It has a partnership with the FraunhoferInstitutfürLasertechnik, Aachen, Germany, where the partners conduct research. On its Board of Directors there are members from the European Laser Institut (ELI). In 2011, the company received an award for the best incubated company of the National Association of Institutions Promoting Innovative Developments – Anprotec.

Analysis of the university-business relationship in the dental materials segment reveals that out of 14 (fourteen) companies, 13 (thirteen) conduct joint research with universities. This relationship becomes closer when we observe that seven (50%) are also incubated companies or graduated from incubators with ties to educational institutions. It should be noted that all of them have R&D projects in the area of bone substitutes. As noted previously, this is an area where Brazil faces shortfalls of quality national products, and the companies do have the technological capacity to develop such products. With regard to the third aspect of this analysis, it is noted that six companies (43%) have highly qualified personnel in company or project management: four have among their partners retired professors (PhD) from federal universities who after retirement went on to engage in business activities; one of the companies has among its directors a technician from the national Institute of Technology, and one of them has at the head of the R&D area a university professor with a PhD.

One of the examples of a company graduated from an incubator, Angelus is a firm specializing in dental products that was founded in 1994 by the dental surgeon Roberto Alcântara, who has "never been satisfied with the artisanal techniques that the people working in this field are required to use." This has led him to create certain products that have made his daily practice faster and more precise. His first step was to seek support to set up the company, and he found out about an incubator in the region where he spent a year , the Industrial Incubator of Londrina, which offered space for company projects and provided management support. He managed to get funding for the Plan of Support for Technological Development (PADT), and with support from the National Bank of Economic and Social Development (BNDES), production at scale was begun. According to the founder of Angelus, moreover, the relationship with universities and research centers began 10 years ago. By the company's fifth year, the products being developed were innovative, and after the fifth year there was a need to insert technology into products to add value. The company sought to interact with universities and research centers to develop products with greater added value. It established partnerships with the Institute for Technological Research (IPT), the Federal University Federal of São Carlos, the Aerospace Technological Center, and various dentistry faculties. In 2005, with the Law of Property and Innovation, funding was made available to the company by the FINEP.

Angelus, a company from the state of Parana, today has clients in more than 50 countries on five continents. Its success on foreign markets is the result of management based on the constant development of new products, a strategy that has already yielded seven national patent deposits with two international patents being drafted. This success in overseas markets, together with its track record of patents and partnerships with research institutions, has helped Angelus to have seven projects approved in calls for tenders for economic subsidy issued by FINEP from 2006 to 2010.

In the field of equipment, eleven companies have submitted projects, with one of them, Angelus, also engaging in projects in the materials field. Of this total, four of them have partnerships with universities, one of these with an international institution. Six companies have been incubated or are graduates of business incubators. In the field of imaging, it can be seen that there are projects for the development of X-ray equipment (Safetsoft and Serv), while Fit has two projects in the field of magnetic resonance, an area where Brazil has less development.

As an example, one can cite DABI AtlanteIndústriaMédico-Odontologica, a company specializing in the production of dental consulting offices, in addition to offering an extensive line of equipment. It is part of the Local Production Arrangement (APL) for Medical, Hospital and Dental Equipment (EMHO) in RibeirãoPreto, an activity conducted by FIPASE in partnership with various actors, notably: SEBRAE-SP, the Municipal Government of RibeirãoPreto, the Secretary for Development of the State of São Paulo, SENAI, CIESP, FIESP, ABIMO, ABDI and the national office of SEBRAE. The aim of this project is to channel efforts towards training, upgrading and strengthening the EMHO sector of RibeirãoPreto, seeking sustainable economic development for the municipality and the region.

In the case of Ortus, the project seeks to produce equipment that as of now is being imported.

With regard to ownership of capital/mergers and acquisitions, one of the companies located in São Paulo has had a controlling interest acquired by a foreign company. Another, also located in São Paulo, is in the process of a merger with another company from the state of São Paulo.

5. Conclusions

The conduct of this exploratory research for the purpose of analyzing innovation projects in the field of odontology approved in the five calls for tenders for Economic Subsidy already carried out by FINEP constitutes a first initiative for development of this theme, in order to find out about new trends in product development in this area, and what are the companies leading this process.

The distribution of company projects in the fields of equipment and materials reveals the stage of innovation in these different areas. Thus, in the equipment field, where Brazil has a great many companies, including those engaged in exports, projects were geared towards supplying possible shortfalls in such a way as to improve quality or create new competencies, such as in the development of imaging projects.

For the materials field where imports are still high, it is observed that companies have exhibited a greater number of projects and have obtained a greater level of funding. The key products to be developed that have caught the interest of companies have to do with bone substitutes and endosseous implants, comprising a new field of research that has been established as a result of advances in biotechnology.
The conduct of new research in this area could lead to identification of new opportunities to undertake research projects at dentistry faculties and companies in the sector.
Considering that 53% of the companies come from business incubators associated with universities, the significance of these hybrid organizations, in keeping with the triple helix model, identifies an important aspect synthesizing human resource training activities and the conduct of university research, a point that will merit exploration in subsequent research.

6. References

Abimo (Associação Brasileira da Indústria de Artigos e Equipamentos Médicos, Odontológicos, Hospitalares e de Laboratórios). 2007.História da Abimoe do Sinaemo: construindo a saúde de um país. São Paulo: Abimo.
Etzkowitz, H. andLeydesdorff, L. 2000. The dynamics ofinnovation: fromnational systems and “mode2” to a triple helix of university-industry-government relationship. Research Policy, 29(2), 411-424.
Etzkowitz, H. (2008). The Triple Helix: university-industry-government, Innovation in Action. Routledge, New York, London.
Etzkowitz, H.; Ranga M. 2010.A Triple Helix System for Knowledge-based Regional Development: From “Spheres” to “Spaces”. Theme paper for Triple Helix 8 International Conference, Madrid, October 2010, http://www.triplehelix8.org/downloads/Theme-Paper.pdf.Accessed on September, 25, 2010.
FINEP (Financiadora de Estudos e Projetos). 2010. Relatório de Avaliação do Programa de Subvenção Econômica(ReportEvaluatingEconomicSubsidyProgram).Availableon
http://www.finep.gov.br/arquivos/programas/subvencao/subvencao_avaliacao1.pdf, accessedonJanuary, 15, 2012.
Furtado, A. T.; Souza, J. H. 2000. Relatório final setor de equipamentos médicos – evolução do setor de insumos e equipamentos médico hospitalares, laboratoriais e odontológico brasileiro: a década de 90. Relatório Final – Departamento de Política Científica e Tecnológica – Instituto de Geociências – Unicamp. Available on http://www.nepp.unicamp.br/d.php?f=41 accessed on February, 15, 2012.
Gutierrez, R. M. V.; Alexandre, P. V. M. 2004. Complexo industrial da saúde: uma introdução ao setor de insumos e equipamentos de uso médico. BNDES Setorial, n. 19, p. 119-155, Rio de Janeiro.
IBGE (Instituto Brasileiro de Geografia E Estatística). 2010. Pesquisa Industrial de Inovação Tecnológica – Pintec. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística/Ministério do Planejamento, Orçamento e Gestão.
IEMI (Instituto de Estudos e Marketing Industrial). 2009. Estudo setorial da indústria de equipamentos odonto-médicohospitalar e laboratorial no Brasil. São Paulo: Iemi/Abimo.
Kim, L. and Nelson, R. R. (Orgs.). 2005. Tecnologia, aprendizado e inovação. As experiências das economias de industrialização recente. Campinas, SP: Editora da UNICAMP.
Lorenzo, H. C. and Mancini, R. F. 2007.A inovação no contexto das micro e pequenas empresas do segmento odontológico no município de Araraquara-SP. XXVII Encontro Nacional de Engenharia de Produção – Enegep. Foz do Iguaçu, PR, Brasil, 09 a 11 de outubro de 2007.
Ministry of Health.(2010). Pesquisa Nacional de SaúdeBucal.http://dab.saude.gov.br/cnsb/sbbrasil/index.html, accessed on January, 10, 2012.
Ministério do Desenvolvimento, Indústria e Comércio, 2011. Balança Comercial brasileira por Município 2011. Available at www.mdic.gov.br, accessed on January, 14, 2012.
Manfredini, M. A. and Botazzo, C. 2006.Ciência & Saúde Coletiva, 11(1), 169-177.
Soares, G. A. 2005. Biomateriais. CGE - Centro de Gestão e Estudos Estratégicos, Brasília.
Pieroni, J. P., Reis, C. and Souza, J. O. B. 2004.A indústria de equipamentos e materiais médicos, hospitalares e odontológicos: uma proposta de atuação do BNDES. BNDES Setorial 31, pp. 185-226.

TAKING A BOTTOM-UP, DESIGN APPROACH TO INDONESIA'S WICKED PROBLEMS

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Abstract
This paper is a case study of Willie Smits, a social entrepreneur, who uses a design approach to tackle the wicked problems of species and plant extinction, deforestation, poverty, crime, and climate change. He has built a collaborative network of community members, businesses, nongovernmental organizations and government agencies to produce successful innovations in Samboja Lestari and Masarang, Indonesia. His successfull efforts offer hope to other social entrepreneurs laboring in wicked problem territory.

Keywords: Wicked Problems, Design Thinking, Bottom-Up Innovation, Forest Regeneration, Sugar Palms, Climate Change

INTRODUCTION

Policy planners coined the term "wicked problems" to describe a certain type of problem they confront with greater frequency. Originally defined as a problem that was difficult to solve because of incomplete, contradictory information and design parameters (Churchman, 1967), Horst Ritell and Melvin Webber (1973) further refined the term to describe problems that cannot be definitively described nor definitively and objectively answered. Drawing on the policy literature, they elaborated on what they saw as their basic characteristics: 1). There is no definitive formulation of the problems; 2). There is no stopping rule to determine when they are solved; 3). Solutions are not true-or-false, but good-or-bad; 4). No ultimate test of a solution to a wicked problem exists; 5). There is no opportunity to learn by trial-and-error since every attempt counts significantly; 6). No set of potential solutions exists nor are there criteria to establish that all solutions have been identified and considered; 7). Every wicked problem is unique; 8). Every wicked problem can be considered to be a system of another problem; 9). An analyst's world view is the strongest factor in explaining which solutions are favored and promoted to resolve a wicked problem; and 10). The planner has no right to be wrong.

Wicked problems have been appearing with greater frequency on the policy agenda—climate change, unemployment, national debts, recessions, terrorism, ecological degradation, water and food shortages, lack of heath care, etc. Although governments and policy makers have launched efforts to cope with these problems, many concluded as had others before them, that wicked problems were indeed intractable (Ackoff, 1974; Conklin, 2006; Horn and Webber, 2007). Others however disagree. They strongly believe that with entrepreneurship, innovation, and a different approach to change, it is possible to tackle wicked problems. Rather than taking a top-down approach reliant on policy experts and lawmakers, they propose launching collaborative, grassroots change from the bottom up. We have come to call them social entrepreneurs (Bornstein, 2007; Praszkier & Nowak, 2011) and this paper documents the efforts of one of them—Willie Smits of Borneo, Indonesia.
The paper is divided into five parts. Section two provides a brief summary of the many approaches to problem solving in wicked problem territory and introduces the design approach which has gained traction of late. Section three provides a detailed case description of Samboja Lestari where Smits and his collaborators launched their redesign work. Results and their implications follow in the section four. We find some startling progress: the regeneration of forest areas and habitats for endangered species, the redesign of communities and their local economies to support the forests and habitats, and changes in the climate as a result of the regenerated forests that have added much-needed rainfall[12].1 Section five concludes the paper with some observations about the design approach to problem solving and the extent to which it can be utilized when confronting wicked problems in other arenas.

[12] Willie Smits, Saving Rainforests, http://poptech.org/popcasts/willie_smits_saving_rainforests;
Willie Smits Replenishes a Rainforest, http://www.momentumconference.org/speaker-presentation/speaker/willie-smits/presentation/confirmed-2009-speaker-26/index.html

STATE OF THE ART

People have evolved a number of techniques over the years to address their wicked problems (Conklin, 2006; Ackoff and Rovin, 2003; Roberts, 2000). We can ignore the problem and hope it goes away. We can "assert that the problem is solved" (Conklin, 2006, p. 21) as when we are trapped in wars we cannot win "just declare ourselves the winner and go home." We can give up trying to get a good solution—"just follow orders, do your job, and try not to get into trouble" (Conklin, 2006, p. 22). We can pass the problem on to others and blame them for the mess (Conklin, 2006, p. 36). Alternatively, we can collect more and more information to analyze—what is referred to as "analysis paralysis." We also can "muddle through" (Lindblom, 1959) and "satisfice" (Simon, 1957) or when all else fails, we can just "go with our guts" or "just use our common sense." These and other shortcuts are illustrative of five general approaches to problem solving: use of Authority, Competition, Science, Engineering and Technology, Taming, and Design[13].

Each problem solving approach has been attempted and each has its limitations. One approach that shows some promise is the design approach. Although no single definition of design exists, most consider it a data-driven, collaborative problem solving process that invites people who 'live' with the problem to frame it, establishes the parameters and constraints of the solution search, identifies creative ideas as solutions, rapidly prototypes and tests solutions in the field, collects feedback, and reframes problems and solutions wherever the data-driven process (not ideology) leads. Or as Buchanan (1992) summarizes, it is "the systematic approach to the invention of possibilities" (p. 13). The key is to think of design as a system of three overlapping spaces, not a sequence of orderly steps (Brown and Wyatt, 2010). In the inspiration space, the problem or opportunity motivates the search for new ideas as potential solutions. In the ideation space, one generates and develops new ideas. And in the implementation space, new ideas are prototyped, tested, iterated and refined (Brown and Wyatt, 2010, p. 33) in order to uncover unforeseen challenges or unintended consequences and to ensure that solutions will have more reliable, long-term success.

At its core, design is "a human-centered approach to problem solving, or what some have referred to as the "return of human beings to the center of the story" (Brown, p. 39). The emphasis is on "fundamental human needs" (p. 19) and it requires creatively navigating among competing constraints of "what is technologically feasible and economically viable without losing sight of what is humanly desirable (Brown, 2009, pp. 15-21). Attempting to balance the competing claims of technology, economy, and humanity, design builds on eight principles that distinguish it from other modes of problem solving. Design is: change oriented; holistic; integrative; 4). collaborative; 5). leader activated and orchestrated; 6. research reliant but not research constrained; 7). embodied; 8). And action oriented. Each of these design characteristics will be explored in greater depth when analyzing the case of Samboja Lestari below.

METHODOLOGY—CASE STUDY

This research relies on a case study of a social entrepreneur, Willie Smits, who uses a design approach to tackle the wicked problems of species and plant extinction, deforestation, poverty, crime, and climate change. He builds a collaborative network of community members, businesses, and government agencies to produce successful innovations and change to Samboja Lestari, Indonesia.

Samboja Lestari is about 25 miles from the port city of Balikpapan in East Kalimantan, Borneo, Indonesia. Originally a rainforest, it was founded about a century ago when oil was discovered in the area and the forest had to be cleared for oil workers. Its story is a common one. Wood cutting accelerated in the 1950s as people flooded into the booming oil town of Balikpapan, roads were built, and loggers felled the dipterocarps for the valuable hardwood lumber. The deforestation left Samboja Lestari vulnerable in the years that followed. Dry periods opened up coal seams just beneath the surface to the air which resulted in CO2 emissions and fires. In addition, the tribal slash and burn techniques, used as a way to fertilize the land, set off a series of fires in 1997 and 1998 in the productive land. The flames spread, burned for weeks and months, and destroyed about 10 million hectares or 38,600 square miles of Indonesia's national forests (Barber and Schweithelm, 2000). According satellite images, the entire region was enveloped in smoke which drifted on to Timor and billowed west leaving 30 cities in Indonesia shrouded in smoke with more than 1,000 hotspots of flames racing up hillsides.[14] [15]The fires released up to 40% of the total carbon

[13] This section on alternative approaches to problem solving has been deleted due to space limitations.

[14] Little, J.B. Regrowing Borneo Tree by Tree, Scientific American, December, 2008, 64 – 71.://www.nature.com/scientificamerican/journal/v18/n5/full/scientificamericanearth1208-64.htm

dioxide emissions worldwide that year (Page et al., 2002). Then in 1982 and 1983, due to El Nino, firestorms ravaged the area and destroyed the small pockets of remaining forest. "Between 1985 and 2005, all of Borneo lost a swath of rainforest the size of Florida."[16]
By 2002, droughts brought crop failures in Samboja Lestari and an almost total extinction of plant and animal life so that the land no longer could sustain agricultural productivity.[17] Flooding occurred five or six times a year. Combined with annual fires, it prompted the growth of alang-alang grass that produces hydrocyanic acid that prevents the germination of tree seeds. To date, deforestation has continued and even has accelerated due to the construction of oil palm plantations for the sale of biofuels. A secondary effect of the deforestation is the exposure of some twenty meters of peat swamp forest, the largest accumulation of organic material in the world. When opened up for growing oil palms, the peat swamp creates "volcanoes of CO_2" that make Indonesia, without any industry, the third largest emitter of greenhouse gases after China and the United States.

The ecological disaster took its toll on human population.[18] Samboja became the poorest district of East Kalimantan with almost 50% unemployment and a high crime rate. Poor nutrition, respiratory problems and hygiene-related health issues drove life expectancy rates low and infant and maternal mortality rates high. Almost a quarter of average income went toward the purchase of drinking water. People began to hunt orangutans to eat, trade and sell to tourists, or just kill them which reduced their numbers by 50%.

Willie Smits entered wicked problem territory through a chance encounter with a caged and dying orangutan discarded in a garbage heap.[19]Taking her home, he nursed her back to life. His solution to the endangered orangutans was to found the Borneo Orangutan Survival Foundation (BOS)[20] in 1991, a nonprofit organization dedicated to the orangutans and their habitat. The goal was to establish a way station to rehabilitate and protect them until the deforestation stopped and they could be returned to the remote woods. "I thought I could save orangutans—put them back in the forest and everybody would be happy. It was a beautiful dream."[21] But Smits finally had to face the fact that his efforts to protect them in Borneo's existing rain forests were failing. Forest destruction was relentless: nearly two million hectares a year were taking some 3,000 orangutans with it.[22]

Learning from his efforts to save the orangutans, Smits decided that the only way to save them was to re-create a rainforest and the only way to do that was to get the local community invested in its creation and protection. He began with 100 local workers and expanded to include 600 families of the local Dayak tribe in the Indonesian province of East Kalimantan.[23] He came to understand that saving the environment also meant addressing local people's needs.

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[15] Indonesian Fires 1997-1998, http://www.oocities.org/capitolhill/congress/5126/sat2.html; Total Ozone Mapping Spectrometer, http://toms.gsfc.nasa.gov/aerosols/indonesia/indonesia.html; Satellite Images of Vegetation Fires in Sumatra, Indonesia, http://www.crisp.nus.edu.sg/coverages/fires/ html index.

[16] Little, J.B. Regrowing Borneo Tree by Tree, Scientific American, December, 2008, 64 – 71.http://www.nature.com/scientificamerican/journal/v18/n5/full/scientificamericanearth1208-64.html

[17] Willie Smits Restores a Rainforest, http://www.ted.com/talks/willie_smits_restores_a_rainforest.html;
Willie Smits Replenishes a Rainforest, http://www.momentumconference.org/speaker-presentation/speaker/willie-smits/presentation/confirmed-2009-speaker-26/index.html

[18] Willie Smits Restores a Rainforest, http://www.ted.com/talks/willie_smits_restores_a_rainforest.html;
Willie Smits Replenishes a Rainforest, http://www.momentumconference.org/speaker-presentation/speaker/willie-smits/presentation/confirmed-2009-speaker-26/index.html

[19] Willie Smits, Orangutans in Danger, http://forum-network.org/lecture/orangutans-danger

[20] BOS Foundation, http://www.sambojalodge.com/AboutBOSFoundation/
Borneo Orangutan Survival, http://savetheorangutan.org/splash.html;
Learning to give, http://learningtogive.org/papers/paper247.html;
BOS Foundation, http://www.sambojalodge.com/AboutBOSFoundation/

[21] Little, J.B. Regrowing Borneo Tree by Tree, , Scientific American, December, 2008, 64 – 71. http://www.nature.com/scientificamerican/journal/v18/n5/full/scientificamericanearth1208-64.html

[22] Little, J.B. Regrowing Borneo Tree by Tree, , Scientific American, December, 2008, 64 – 71. http://www.nature.com/scientificamerican/journal/v18/n5/full/scientificamericanearth1208-64.html

[23] Little, J.B. egrowing Borneo Tree by Tree, Scientific American, December, 2008, 64 – 71. http://www.nature.com/scientificamerican/journal/v18/n5/full/scientificamericanearth1208-64.html

So how does one re-create a rainforest to meet people's needs? The project began in 2001 with the purchase of land near Samboja. BOS began buying land around the Dayak village and paying villagers what Smits considered to be a generous price.[24] In 2003, BOS purchased 1,200 more hectares (4.6 sq. miles), most of it through credit from the Gibbon Foundation (also under Smits' management). To sustain the financing, BOS subsequently launched the "Create a Rainforest" initiative where donors could symbolically adopt square meters of rainforest and review the progress of their contribution using Google Earth satellite images to compare data from 2002 with current data on the reforestation project.[25]

Smits' next step was to create a three-hectare nursery using seeds he had collected from more than 1,300 species, some from orangutan feces. But since the soil was infertile, low in nutrients, and choked with "hard as steel" plinthite clods, soil preparation was imperative to give the seedlings a chance of survival. Drawing on his doctoral dissertation on mycorrhiza and his background in microbiology, Smits started making compost. He mixed organic wastes, sawdust, fruit remnants from the orangutan cages, manure from cattle and chickens from his other projects in Kalimantan, and a special microbiological agent made from sugar and cow urine. Thanks to the humid local climate, each batch of compost was ready every three weeks.[26]

Next, Smits and his partners began planting trees, but not just any trees. They planted Acacia mangium and other fast-growing trees to restore the microclimate for later species, provide soil protection and to provide shade to kill off the alang-alang grass that secrets cyanide from its roots. They also added special fungi that breaks down the grass and provides important nutrient pumps to provide critical bacteria and microorganisms. Beneath the fast-growing trees, they planted primary, slower-growing rain forest trees. In between the trees, they planted agricultural products—pineapples, beans, ginger, and corn, and in a second phase papyrus and bananas, and in the last phase chocolate and chilies, to reduce the competition and add crop fertilizers for the trees.[27]

In all, the 2,000 hector forest is divided into three zones.[28] [29] The outer zone is a 100 meter wide ring of sugar palms which serves as a fire protection—sugar palms do not burn easily—and they also are flood resistant. A fence of thorny palms separates the fireproof ring from the reforestation zone in the middle which is dedicated to water harvesting and conservation. It also serves as a barrier to protect the wildlife within its boundaries. Here, in the heart of Samboja Lesteri, grows a wide variety of trees selected for their benefits to the wildlife. Sugarcane, papya and lemon trees feed the orangutans, birds and other wildlife. The third, innermost zone, around 300 hectors, has been set aside for activities supporting the emerging rain forest: arboretum and forest research facility, sanctuaries for captive animals that cannot be returned to the wild, an education center where visitors can learn about conservation, and an eco-lodge (Samboja Lodge) to generate income from guests.

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[24] Little, J.B. Regrowing Borneo Tree by Tree, Scientific American, December, 2008, 64 – 71. http://www.nature.com/scientificamerican/journal/v18/n5/full/scientificamericanearth1208-64.html

[25] Create a Rainforest, http://www.createrainforest.org/en/idea;Samboja Lestari, Part 1, http://www.youtube.com/watch?v=pWAirgXwiI4

[26] Thompson, S. Borneo Experiment Shows How Saving the Apes Could Save Ourselves, This Magazine, May 17, 2010, http://this.org/magazine/2010/05/17/apes-saving-humans/

[27] Willie Smits Restores a Rainforest, http://www.ted.com/talks/willie_smits_restores_a_rainforest.html;
Willie Smits Replenishes a Rainforest, http://www.momentumconference.org/speaker-presentation/speaker/willie-smits/presentation/confirmed-2009-speaker-26/index.html

[28] Little, J.B. Regrowing Borneo Tree by Tree, , Scientific American, December, 2008, 64 – 71. http://www.nature.com/scientificamerican/journal/v18/n5/full/scientificamericanearth1208-64.html

[29] Willie Smits Restores a Rainforest, http://www.ted.com/talks/willie_smits_restores_a_rainforest.html;
Willie Smits Replenishes a Rainforest, http://www.momentumconference.org/speaker-presentation/speaker/willie-smits/presentation/confirmed-2009-speaker-26/index.html

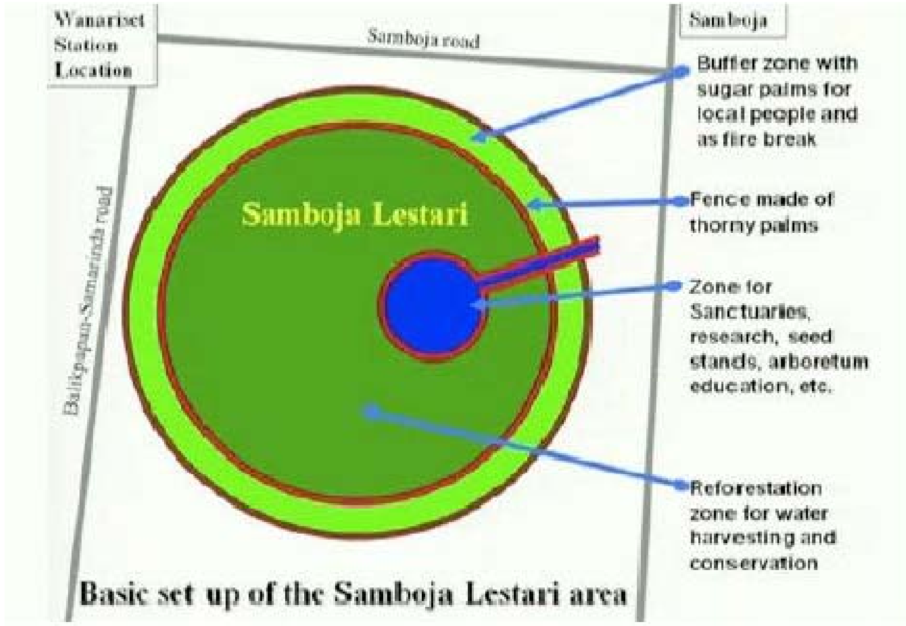

Figure 1. Samboja Lestari schematic[30]

But how does a re-created rainforest sustain the community, meet its needs, and protect the rainforest at the same time? Each family that sold its land not only got money in return but jobs and education. They could work in fire protection, reforestation, farming, construction, or care for the orangutans. In addition, they got a plot of land on which to live.[31][32] Plots were developed in steps. First roads were built to bring people water and electricity. Then trees were planted for shade and boundary making. In step two, sugar palms and salak palms were planted under the shade trees, while thorny palms provided a fence to protect people and provide a sanctuary for the orangutan. In Step 3, removal of some of the shade trees promoted the flowering and fruiting of the sugar palms and enabled the building of a 6 x 12m wooden house. Families could use the Acacia trees as building materials for their houses and waste wood for cooking and making handicrafts. Each family tending a plot must clear the ground of alang-alang and all undergrowth that is flammable. Then they are encouraged to grow their crops between the trees and sell part of their fruit to the orangutan project. According to Muhammad Trafakhur Rochim, the Indonesian coordinator of human development, the workers have an advantage. "The contract to supply food for the orangutans is worth 125 million Indonesian rupiah (about 14,000) a month for farmers for a total of 150 people," while he estimated that "the average monthly incomes for a worker in the villages is between one and two million rupiah.[33] They also get contracts for selling the sugar water from the palm trees to locally produce ethanol and energy. In 2007 Smits, one of the founders of the Masarang Foundation, opened a palm sugar factory[34] that uses thermal energy to turn the juice tapped daily from sugar palms into sugar or ethanol which then returns electricity to the community. In all, 648 families derive an income that supports 3000 people. Thus, Smits' design not only produced crops for immediate use, but staggered planting enabled other trees to grow and produce fruits, timber, fuel, and permanent income from the sugar water.

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30 Orangutan Outreach, http://www.mnn.com/sites/default/files/user-39/samboja-lastari-red-apes.jpg

31 Little, J.B. Regrowing Borneo Tree by Tree, Scientific American, December, 2008, 64 – 71. http://www.nature.com/scientificamerican/journal/v18/n5/full/scientificamericanearth1208-64.html

32 Willie Smits Restores a Rainforest, http://www.ted.com/talks/willie_smits_restores_a_rainforest.html;
Willie Smits Replenishes a Rainforest, http://www.momentumconference.org/speaker-presentation/speaker/willie-smits/presentation/confirmed-2009-speaker-26/index.html

33 Thompson, S. Borneo Experiment Shows How Saving the Apes Could Save Ourselves. This Magazine, May 17, 2010, http://this.org/magazine/2010/05/17/apes-saving-humans/

34 Masarang Palm Sugar Factory, http://www.sugarpalmtree.com/palmsugar-trip-tomohon.html; http://www.masarang.nl/en/about-masarang/

To sustain the program, not only did it have to adhere to local cultural values ("everyone is family"), but it had to be supported by the local people to ensure a transparent, fair system to prevent corruption and poaching of the animals and woods.[35] A system of justice evolved in Samboja Lestari where thirty-four groups of 20 families each self monitored to ensure accountability with the community's standards and protection of the habitat. If a member violates the community agreements, the other members have to decide what is going to happen to him. In North Sulawesi the community has a democratic culture and runs a cooperative so it relies on the local justice system to sustain the community agreements.[36] Thus, by establishing both economic and political legitimacy, Smits was able to create the incentives for long-term ecological and economic restoration.

FINDINGS AND INTERPRETATION

Findings. By 2008, Balikpapan in East Kalimantan was no longer the poorest district. Smits' videos summarized some the results.[37] There was a return of biodiversity with no more fires or flooding. Today it is home to a lush rain forest with almost 700 butterfly and insect species and 578 plant species. Half million trees belonging to 1,300 species are now growing on 1,000 hectares. Nearly 2,000 homeless and mistreated orangutans have been provided a safe haven and around 700 reintroduced back into the wild. Bird species are up from 5 to 137 which includes the rare Harnbill. Reptile species have increased to 30 and primate species to 9. They include the Sun Bears, rescued from deforested areas or confiscated from the illegal pet trade, as well as the endangered Proboscis monkeys, porcupines, pangolins, mouse deer. In addition, the climate around Samboja Lestari has changed. The temperature has dropped 3-5 degrees Celsius and the air humidity is up by 10%. After three years into the project, the cloud cover increased 11.5% and the rainfall by 25%. Not only did rainwater prevent forest fires, but the reforested land became a source of fresh water. Smit's Foundation, with the help of a grant from the Dutch government, as well as local companies in East Kalimantan, created the infrastructure to deliver clean water. In partnership with the Balikpapan City Water Company, BOS supplies water to approximately 30,00 people (7,000 households) in the neighboring cities and receives a portion of the profits which are returned to sustain the Samboja Lestari rainforest.[38] [39] City inhabitants, aware that their water supply depends on the rainforest, have additional incentives to protect it.

Interpretation. Willie Smits' efforts in tackling wicked problems are the embodiment of the design approach to problem solving. Although he only occasionally uses the term "design"[40] to describe his work in Samboja Lestari and Masarang, the foundation he set up in North Sulawesi, Indonesia in 2001,[41] his activities, intentions, and behaviors as well as the results he and the community have achieved, are very compatible with the design approach.

Change-Oriented Design. Willie Smits launched his change agentry trying to save the life of one orangutan and then expanded his mission to look after others given to him. Needing additional space and a longer-term solution of rescuing, rehabilitating, and releasing orangutans into the wild, he created the Borneo Orangutan Survival Foundation in 1991, the biggest primate conservation NGO worldwide, now employing between 600 and a thousand people.[42] Initially established with the help of thousands of schoolchildren in Balikpapan contributing small amounts of money, it now operates under formal agreement with the Ministry of Forest and has almost a 1,000 orangutans under its care (Thompson, 2010).

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[35] Willie Smits Restores a Rainforest, TED talk, "Willie Smits restores a rainforest". http://www.ted.com/talks/willie_smits_restores_a_rainforest.html;

[36] Willie Smits Restores a Rainforest, TED talk, "Willie Smits restores a rainforest". http://www.ted.com/talks/willie_smits_restores_a_rainforest.html;

[37] Willie Smits Restores a Rainforest, http://www.ted.com/talks/willie_smits_restores_a_rainforest.html;
Willie Smits Replenishes a Rainforest, http://www.momentumconference.org/speaker-presentation/speaker/willie-smits/presentation/confirmed-2009-speaker-26/index.html

[38] Ashoka, Innovators for the Public, Willie Smits, http://www.ashoka.org/fellow/willie-smits

[39] Drinking water is a serious problem in the area. In Balikpapan, a nearby city, population of 550,000, only 50% have tap water. Eighty percent of the land is surrounded by salt water. Artesic wells have been shut down due to salt water intrusion and only deep wells provide potable water.

[40] Willie Smits, The Amazing Power of Sugar Palms, http://www.qi-global.com/10ws

[41] Masarang Foundation, http://www.masarang.nl/en/;

[42] Borneo Orangutan survival Foundation (BOSOhttp://learningtogive.org/papers/paper247.html

To ensure orangutan survival against the onslaught of mechanical logging that was taking over two million hectares a year, Willie Smits then understood he needed to recreate rainforests—the orangutan's natural habitat—from totally denuded land. Reforestation first began in Samboja Lestari and then expanded into Masarang and a number of smaller areas of North Sulawesi, Indonesia where now more than 1 million trees have been planted.[43] Moving counter to traditional views that rainforest can't be recreated once they have been destroyed,[44] Smits invented and introduced new land management techniques that made rainforest revival possible—sustainable farming and remote monitoring of forests through satellite coverage. (See below). And to ensure their long-term viability against logging pressures, Smits developed new job opportunities for thousands of people and engaged them as protectors of the forest to insure its sustainability. (See below). The results of these changes have not only have created rainforests for the orangutans, ensured jobs and a livelihood for the people in the local communities, but, as noted above, they have stopped the flooding and peat fires, and changed the climate by increasing the cloud cover and rainfall and decreasing the temperature.[45]

Holistic Design. Smits sees the world in system terms—"life in harmony"—a phrase he uses in all of his presentations to describe the interconnections of all systems among the animal world, the planet, and humankind. The center of his system for conservation and community renewal in Indonesia is the sugar palm, the deep-rooted feather palm called *Arenga pinnata* which he has studied for years.[46] The sugar palm has unique features from a systems perspective. It can grow in poor soil types, even on steep land eroded by logging and fire that is useless to both man and nature, a condition that afflicts much of the land in Indonesia. Using a process he has developed, a forest with sugar palms can be re-grown within five years, and with it, the ecosystem and diversity of animal life returns. Sugar palms also turns out to be highly productive for the community. Calling it a "sweet solution," (Figure 2) [47] Smits has demonstrated that in only a few years after a tree is planted, a daily amount of juice from it can be tapped by cutting a thin slice off a branch. Mature trees can produce up to 50 litres a day with a sugar concentration of about 11%, without destroying the tree, without removing, on balance, nutrients from the soil, or without cutting off branches and fruit to harvest the energy. With sunlight, CO2, and little water and no fertilizer, sugar palms can produce over 60 different kinds of products ranging from bio fuel (e.g. bio-ethanol) palm sugar, bio plastics, and extremely strong fibres that can be used for roofing, medicine and wood (after the tree's life cycle has ended). Comparisons with other crops have established the superiority of the sugar palm. For example, it provides three times more energy than sugar cane. Thanks to its efficient leaf structure that enables it to capture sunlight, photosynthesis takes place during a longer time period per day and harvest occur twice daily throughout the year.[48] As additional advantages, the sugar palm has a deep root system that provides protection against soil erosion. It also is fire and flood resistant, and because it only grows in a diverse forest, it is able to support and maintain the integrity of a bio-diverse forest.

[43] Masarang Foundation http://www.masarang.nl/en/initiatives/index.jsp?USMID=82

[44] Little, J.B. Regrowing Borneo Tree by Tree, Scientific American, December, 2008, 64 – 71. http://www.nature.com/scientificamerican/journal/v18/n5/full/scientificamericanearth1208-64.html; Thompson, Borneo Experiment Shows How Saving the Apes Could Save Ourselves , This Magazine, May 17, 2010, http://this.org/magazine/2010/05/17/apes-saving-humans/

[45] Masarang Foundation, http://www.masarang.nl/en/initiatives/index.jsp?USMID=82

[46] Sugar Palm should not be confused with the Oil Palm which is highly destructive of the ecosystem. Although it is a cash crop easily grown in Indonesia, oil palms are not sustainable to harvest. Their operations require clear cutting, uncontrolled burning, and illegal logging that destroy the tropical rain forests leaving orangutans with no food or a place to live. See the Amazing Power of Sugar Palms, http://www.qi-global.com/10ws; Willie Smits, Saving Rainforest http://poptech.org/popcasts/willie_smits_saving_rainforests

[47] Sugar Palm: A Miraculous Tree http://www.masarang.nl/en/initiatives/index.jsp?USMID=90

[48] Sugar Palm: A Miraculous Tree http://www.masarang.nl/en/initiatives/index.jsp?USMID=90

Figure 2. Life in Harmony[49]

Smits understands that the vast potential of the sugar palm only can be unlocked when working in a holistic way with production, forest preservation, and community development all operating in tandem. For example, as the core of a waste-free system to produce organic sugar, alcohol, and ethanol (for domestic and foreign use), the sugar palm also provides jobs while producing green and CO2- positive products.[50] Since harvesting the tree sap relies on manual tapping, local farmers have employment. One farmer typically is responsible for about six trees and receives an income that is much higher than regular small farmers. Increased income enables the farmers' families to escape poverty, their children to study, and as their incomes increase, they are less inclined to cut down the rainforest illegally. The locals also do not have to work in polluting industries such as gold and coal mines or in the destructive oil palm plantations. The sugar palm *a*lso provides food security: the fruit can be harvested and sold as a delicacy; a starch, sago, can be extracted from the stems; and the high-carbohydrate juice can be used to make a palm sugar that is a healthier substitute for white cane sugar. Thus, the Arenga sugar palm serves many purposes but most importantly, it is the anchor in a very sophisticated system that provides energy, jobs, enhanced local food security, and safeguards to the environment.[51]

***Integrative Design*.** In pursuing change Smits proceeds as nature does it—with an integrative design.[52] He began as a rainforest inventor with over 30 of his own inventions such as the gene bank for indigenous trees that he set up as a young forestry engineer. He also has done groundbreaking research into fungi, what he calls "the key to the regeneration of the tropical rainforest." His studies of the mycorrhizal fungi have improved the uptake of Meranti tree's water and nutrients from the soil, and with the use of this fungus, he has achieved faster growth of young seedlings. His later inventions, on which he has a patent pending,[53] have focused on the ethanol production. Yet

[49] Masarang Foundation, http://www.masarang.nl/en/about-masarang/

[50] Sugar Palm: A Miraculous Tree http://www.masarang.nl/en/initiatives/index.jsp?USMID=90

[51] Sugar Palm: A Miraculous Tree http://www.masarang.nl/en/initiatives/index.jsp?USMID=90

[52] Willie Smits, Saving Rainforest http://poptech.org/popcasts/willie_smits_saving_rainforests

[53] Patentdocs, http://www.faqs.org/patents/inventor/smits-6/

Smits insists that creative ideas and reliance on science and technology need to be balanced with the community's needs. Building on his expertise as a forester and microbiologist, and extending it into nature conservancy, community empowerment and economic development, his approach is an interdisciplinary one that refuses either/or thinking.[54] He believes that conservation and development and meeting people's needs do not have to be in conflict. His worldview is founded on the principles of "People, Profit, and Planet."[55] He asserts that solutions to environmental problems must not be addressed in isolation, but rather they must link multiple interests. They must yield money (be economically feasible), be ecologically sustainable, establish clear legal status (e.g. work in a local e.g. legal context), be socially acceptable, and science-based (Figure 3).

Figure 3. The Sweet Solution of the Sugar Palm Tree[56]

Masarang provides a good example of his integrated approach to design.[57] When replanting the forest with approximately 1 million trees, 200 jobs were created in sustainable forestry and sugar-palm and fruit cultivation. Seven formerly dried up springs now provide water. Flooding has stopped in the lower lands. With better water management and improved climate (increase in rain and lower temperatures), rice production has added one extra harvest a year, representing a quarter of million kilos of extra rice. The forest is now home to endangered species and plants and absorbs an estimated 5,000 additional tons of CO2 per year. The animal rescue center at Masarang has given shelter to more than 2,000 animals of 110 different endangered species since it opened. Volunteers and local employees rehabilitate the animals, if possible, before returning them to nature.

Collaborative Design. Smits' projects involve contributions of the many—a large and growing network of government officials, international foundations, businesses, and ordinary citizens online who donate money to his foundations. But most notable in his bottom-up effort is his "design team"—six thousand sugar palm farmers in North Sulawesi through Smits' Masarang Foundation and thousands of others in Samboja Lestari through the Borneo Orangutan Survival Foundation.[58] All projects are carried out with the cooperation and active participation of the local people. Through his messages and actions, Smits underscores his central point—nature preservation is only sustainable if it is rooted in the local community and the locals benefit from it and support it. To achieve these

[54] Willie Smits, Replenishing a Rainforest, Momentumand Tides, http://fora.tv/2009/09/08/CARBON_Willie_Smits_on_Replenishing_a_Rainforest

[55] Qi, Global Network of Innovators, People, Profit, Planet Approach, http://www.qi-global.com/10ws1

[56] Masarang Foundation, http://www.masarang.nl/en/initiatives/index.jsp?USMID=90

[57] Masarang Foundation, http://www.masarang.nl/en/

[58] Masarang Foundation, http://www.masarang.nl/en/initiatives/index.jsp?USMID=89

ends, clear legal status of the land is established in order to protect it from outside influence and to ensure it belongs to the foundations that govern them and the people who live and work the land.[59]

Collaborative culture is reinforced in all Smits' projects.[60] In Northern Sulawesi, for example, cooperatives have been set up where people choose their own coordinators and representatives and have annual shareholders meetings. Smits calls it a "totally democratic system" in which people are fully involved and the decision making is collaborative. In the Minahasa region, the Mapalus project, which stands for "doing together," reinforces another community tradition.[61] Here farmers cultivate the land together as a group and move from one piece of land to the next. Members of the project also coordinate their efforts to determine which crops to grow in order to ensure a diverse range of vegetables and to avoid overproduction of a given crop that would yield lower prices in the market. Based on the knowledge they gain from scientific studies (see below), crops are carefully selected to produce in ecologically optimal way. Some are selected because they positively influence each other's development in terms of nutrients, sunlight, and protection against disease. Others are rotated to avoid deleterious effects e.g. farmers are asked not plant tomatoes after potatoes because both are sensitive to the same fungi. Through these collaborative efforts, the Mapalus project of Masarang has required less fertilizers and pesticides.[62]

Leader Activated and Orchestrated Design. Leadership from a design perspective outlines a vision and attracts and engages others in its quest.[63] In 1991, Smits founded the Borneo Orangutan Survival Foundation developing a "land purchasing" initiative called "create a rainforest" where people from all over the world symbolically could "adopt" square meters of rainforest. Donors viewed and followed the progress of "their land" with Google satellite images to compare and contrast the land before and after the reforestation. Since its inception, BOS has grown to be a major foundation with sister organizations in the United States, Netherlands, Australia, Germany, Austria, England, Japan, Canada, Denmark, Switzerland and France.[64] Smits is also is one of the founders and chairman of the Masarang Foundation that was established in 2001 and dedicated to forest restoration and the empowerment of local people. He also designed and served as director at Schmutzer Primate Center at the Ragun Zoo that opened in 2002. In 2006, he launched TV Dimesi (RV 5 Demensi), a North Sulawesi local television channel that is based in Tomhon. Reputed to be the number one television news source, it is an affiliate of Voice of American, Deutsche Welle, Media Nusantara Citra, and TV Edukasi, and other national television with services to more than 4 million people in more than 8 counties in North Sulawesi and North Maluku Indonesia.[65] And in 2007, he opened a sugar palm factor that uses thermal energy to transform the juice from sugar palms into ethanol which returns cash and power to the community (see below). For these and other achievements, Smits has received numerous awards. He was the first Indonesian with foreign roots to become "Hero for the Development of Indonesia," a prize given to him by the

[59] Willie Smits Restores a Rainforest, http://www.ted.com/talks/willie_smits_restores_a_rainforest.html;
Willie Smits Replenishes a Rainforest, http://www.momentumconference.org/speaker-presentation/speaker/willie-smits/presentation/confirmed-2009-speaker-26/index.html

[60] Willie Smits Restores a Rainforest, http://www.ted.com/talks/willie_smits_restores_a_rainforest.html;
Willie Smits Replenishes a Rainforest, http://www.momentumconference.org/speaker-presentation/speaker/willie-smits/presentation/confirmed-2009-speaker-26/index.html

[61] Masarang Foundation, http://www.masarang.nl/en/initiatives/index.jsp?USMID=81
and produced higher agricultural yield. To date, around 10,000 farmers are involved in this project.

[62] Masarang Foundation, http://www.masarang.nl/en/initiatives/index.jsp?USMID=89

[63] Smits' early preparation for collective leadership was an educational one. He completed a master's degree in tropical forestry in the Netherlands after his first visit to Indonesia in 1980. In 1985, Indonesia's forestry ministry invited him to return to address the problem of fungi that was attacking hardwood trees. Continuing his interest and studies, he became a senior advisor to the Indonesian Ministry of Forests and eventually received a doctorate in tropical forestry and soil science from the Agricultural University of Wageningen, Netherlands. From these early beginnings as a forestry engineer and microbiologist, Smit launched his conservation and organizational efforts in the community. He started working at Wanariset, the world's largest orangutan reintroduction project in the tropical rainforest near Balikpapan in Indonesia's East Kalimantan province. He also started the Wanariset forestry research station to study reforestation techniques. In the early '90s, he was team leader of the Tropenbos Kalimantan Project, an international partnership between the Indonesian Ministry of Forestry and the Tropenbos Foundation.Subsequently he became director and eventually chairman of the Gibbon Foundation that focuses on animal conservation in Indonesia, an advisor to the Indonesian Orangutan Survival Program, and chairman of the Board of Orangutan Outreach.

[64] Orangutan Survival Foundation, http://learningtogive.org/papers/paper247.html

[65] TV 5 Dimensi, http://en.wikipedia.org/wiki/TV_5_Dimensi

president in 1994,[66] and in 1998, the first non-Indonesian to receive the Satya Lencana Pembanguan Award.[67] He has been singled out by the Rocky Mountain Institute as the world's leading protector of orangutans and their habitat and with Samboja Lestari as possibly "the finest example of ecological and economic restoration in the Tropics."[68] He was elected as a Ashoka Fellow in 2007 which recognizes him as a leading social entrepreneur with innovative solutions to social problems.[69] In 2007, the Masarang project was one of the finalists in the World Challenge and the BBC named Masarang on the the 12 best charities in the world, and in 2009, won the Padma Award granted by the Indonesian Ministry of Energy.[70] In 2010, Smits received Conde Nast's 21st Annual Environmental award[71] and he was knighted in the Netherlands for his conservation work.[72]

Research-reliant Not Research-constrained Design. Trained as researcher with natural proclivities as an inventor, Smits views science and technology as handmaidens to his efforts in reforestation, conservation, land management and sustainable agriculture. But rather than searching for universal scientific principles, his purpose is the design of a unique system for a particular region in Indonesia that is ecologically sound, socially acceptable, and economically viable. To this end he has launched extensive data collection using multiple methods to guarantee transparency, validity, and measurable results. In the region of Masarang, for example, he has built a unique biodiversity database to chart the distribution of animals and plants and uses it as a tool to understand the development of biological diversity in this region.[73] Conducting interviews with farmers, he and his team find out what farmers have grown, what the proceeds and problems are (e.g. crop diseases) in each area. Combining the data he creates an image of which crops do best at which place at what time. Students affiliated with local schools and universities also provide a network of measurements e.g. using small herbs as soil quality index. They also examine the soil for its composition and possible pollution and map microclimates by location. All the data are stored in GIS (geographic information system) database.[74] In collaboration with the European Space Agency, Smits then combines the GIS data with satellite imagery and displays the data in three dimensional satellite maps. With land divided into strips, the maps reveal the topographical images of soil types, climate, crops and their conditions. Using GIS and satellite images, the cooperative in Masarang can direct their activities and decide where and when to extract the sugar palm's liquid. They also can identify the best roads for oxcart and automobile transport, the village processing points, and the placement of the product for gravitational transmission to the coast for export. It also gives them the ability to predict crop yields and determine the amount of labor needed for planting and cultivation. Smits also uses GIS and satellite imagery to monitor every single tree from space. Ten percent of all trees are re-measured once a year[75] and the ground carbon is monitored in detail. Thus, using these data, the community builds an understanding of how an ecosystem is formed and evolves, and most importantly, how a vanished ecosystem can be rebuilt.

Embodied Design. As the above examples illustrate, Smits follows the principle of embodied design. His intense observations and insistence on learning from nature[76] to find practical solutions to pressing problems in his local community mark him as someone who "*learns in place.*" His crucible and test bed are in the communities and deforested areas of Borneo and North Sulawesi that offer him opportunities to experiment, develop prototypes, and generate immediate feedback on his regeneration and renewal efforts. Thus, Smits "learns by doing." His prototypes e.g. the use of bamboo to filter waterways, or his pattern for planting sugar palms, are treated as experiments. When

66 Masarang Foundation, http://www.masarang.nl/en/about-masarang/willie-smits-en.shtml

67 Willie Smits, Wikipedia, http://en.wikipedia.org/wiki/Willie_Smits

68 Willie Smits, Handing Around with the Orangutans, http://www.odemagazine.com/doc/60/willie-smits-hanging-around-with-orangutans/

69 Ashoka, http://www.ashoka.org/fellow/willie-smits

70 Masarang Foundation, http://www.masarang.nl/en/about-masarang/

71 Willie's War: The 21st Annual Environmental Award, http://www.concierge.com/cntraveler/articles/503118?all=yes

72 Willie Smits, Wikipedia, http://en.wikipedia.org/wiki/Willie_Smits

73 Willie Smits Shares Methodology for Sustainable Forests, fhttp://www.esri.com/news/arcnews/winter0910articles/willie-smits.html; Willie Smits, Saving Rainforest http://poptech.org/popcasts/willie_smits_saving_rainforests;

74 Willie Smits Shares Methodology for Sustainable Forests, fhttp://www.esri.com/news/arcnews/winter0910articles/willie-smits.html; Willie Smits, Saving Rainforest http://poptech.org/popcasts/willie_smits_saving_rainforests;

75 Willie Smits Restores a Rainforest, http://www.ted.com/talks/willie_smits_restores_a_rainforest.html; Willie Smits Replenishes a Rainforest, http://www.momentumconference.org/speaker-presentation/speaker/willie-smits/presentation/confirmed-2009-speaker-26/index.html

76 Willie Smits, Saving Rainforest http://poptech.org/popcasts/willie_smits_saving_rainforests

results are positive, the idea is applied elsewhere. One prototype, the sugar palm village hub, is a green factory in a box that attempts to imitate nature as an integrated, sustainable production system. Illustrated in Figure 4, its purpose is to enable local rural communities in remote Indonesian regions to process sugar palm juice in small factories and in so doing provide local employment, the generation of their own local energy supply, and preservation of their forests.[77]

Figure 4. Factory in a Box[78]

Other prototypes come from Smits' research studies in biodiversity, carbon, climate, and costs. He calls them his "recipes."[79] He starts with things he can control e.g. the land to determine what trees and vegetables grow where and with what nutrients. He then drops these ingredients on a map to calculate the fertilizer and labor and skills needed and the costs associated with different soil types. Outputs are then measured to determine the recipe's results. If successful, they are used to set production targets, for example he learned that only a thousand trees could be planted in a day to keep the jobs stable. When combining all the recipes from different plots of land, he then has a business plan, a work plan that enables him to optimize production for the available labor and land.

Action Oriented Design. An action orientation requires the implementation of an "experience blueprint" to test new ideas for their resonance and acceptance by others, especially those offered by competitors. It also necessitates attention to process—lots of stories, advocacy, and a constant stream of information to remind people in a meaningful way what the problems are and how to address them. Smits excels at both. In 2007, using fuel leftovers from the state energy company Pertamina's geothermal gas production, he opened a sugar palm factory in Masarang. Farmers bring nira, the white sap they tap from the sugar palm trees, for processing in the factory, similar to the one shown in Figure 4. It uses thermal energy to turn the juice tapped from sugar palms into sugar and ethanol as well as soy-like sauce, vinegar, even rum and beer. Run by the Masarang Foundation, it is a "zero waste" facility

[77] The Amazing Power of Sugar Palms, http://www.qi-g; Willie Smits - Conservation" http://tedxtalks.ted.com/video/TEDxPearlRiver-Willie-Smits-Con;Willie Smits: Replenishing a Rainforest, http://fora.tv/2009/09/08/CARBON_Willie_Smits_on_Replenishing_a_Rainforest;

[78] Orangutan Outreach, http://www.orangutanoutreachnederland.nl/wp-content/uploads/Village_Hub.jpg

[79] Willie Smits Restores a Rainforest, http://www.ted.com/talks/willie_smits_restores_a_rainforest.html;
Willie Smits, Saving Rainforest http://poptech.org/popcasts/willie_smits_saving_rainforests;

where even furniture is made from waste wood and every stem and branch of the sugar palm is utilized. Not only does it provide income for 648 families, but it saves 200,000 trees per year from being cut down and used as fire wood.[80] Smits is convinced this "environmentally friendly factory" could be a model for other Indonesian regions. Eight other provinces have an abundance of sugar palms, but according to Smits, they have not done much to capitalize on them. He contends that if Indonesia made the most of its sugar palms, its need for imported sugar would disappear in two years.[81]

Reliance on sugar palms has other benefits as well. In Tomohon, the area in which he lives, a farmer whose fields have three sugar palms can earn at least Rp 70,000 (US$6) a day working less than two hours tapping the trees.[82] Even more significant, sugar palms are a new source of energy that can produce more energy per hectare per year than other bio fuel crops yet without the negative impacts of other well-known bio-fuels.[83] To champion these ideas, he founded and is chief science officer of Tapergy, an organization that advocates sugar palms as a viable alternative energy source.

As part of his action orientation, Smits spends an increasing amount of activity disseminating information, doing outreach and education, and raising public awareness. His talks at QiGlobal[84] and TED[85] have brought him and his ideas worldwide recognition. A movie is in production to energize 1,000,000 young people to challenge deforestation.[86] But what is really capturing attention is his design challenge to alert the world to the dangers and costs of palm oil which is used in everything from beauty products to biofuels. According to the Worldwatch Institute,[87] Indonesia is the planet's largest supplier of palm oil. Its plantations annually subsume some 80,000 acres of forest per year and with it disappears the vast part of the biodiversity of Southeast Asia. Only 300 million acres of tropical Indonesian forests remain.

Smits believes the key to stopping this destruction is the sugar palm. Smits details its advantages over Brazil's sugarcane and its success.[88] "Palm sugar produces three times more sugar than sugarcane;" it has a "lower glycemic index than regular sugar" and does not have the deleterious impact on human health; it does not deplete the soil and then fail to thrive; it only grows in mixed, secondary forests and allows other species of plants and vegetables to co-exist andflourish; after two or three years, it requires no pesticides or fertilizers unlike the oil palm; it can grow on a mountain, be harvested daily, and provide 20 times more jobs for tappers and farmers compared to oil palm or sugarcane. According to Smits, "by 2030, we could replace all of the world's oil with ethanol from sugar palm."[89] It is the only form of renewable energy that can be produced on a large scale and is ready to go today.

Moving innovative ideas to scale is what Ashoka[90] is all about and one of the major reasons Smits was elected to be an Ashoka Fellow in 2007.[91] To be inducted, fellows undergo and meet a rigorous search and selection process. As "change makers for the world" and "innovators for the public," they are leading social entrepreneurs whose solutions to major social problems have potential to change patterns in their countries and beyond. Smits and others believe that his innovative sugar palm solutions to stop deforestation, protect endangered species, and sustain biodiversity in Indonesia may well be solutions for other areas of the globe. The orange regions in the Figure 5 map

[80] Masarang Foundation, http://www.masarang.nl/en/initiatives/index.jsp?USMID=89

[81] Willie Smits, Restores a Rainforest , "Willie Smits restores a rainforest";
Willie Smits Video, The Amazing Power of Sugar Palms, http://www.qi-global.com/10ws;

[82] Amazing Power of Sugar Palms, http://www.qi-global.com/10ws;

[83] The Amazing Power of Sugar Palms, http://www.qi-global.com/10ws; Sugar Ethanol, http://www.sugarpalmethanol.com/2010/06/tapergy.html;

[84] The Amazing Power of Sugar Palms, http://www.qi-global.com/WILLIE-SMITS

[85] Willie Smits, Restores a Rainforest, http://www.ted.com/talks/willie_smits_restores_a_rainforest.html

[86] Masarang Foundation, http://www.masarang.nl/en/media-gallery/index.jsp?USMID=103

[87] Worldwatch Institute, http://www.worldwatch.org/node/6059

[88] Willie's War: The 21st Annual Environmental Award, http://www.concierge.com/cntraveler/articles/503118?pageNumber=2

[89] Willie's War: The 21st Annual Environmental Award, http://www.concierge.com/cntraveler/articles/503118?pageNumber=2

[90] Ashoka Fellows, http://www.ashoka.org/fellows; Willie Smits, Asoka Interview, http://www.youtube.com/watch?v=Gk9NUwxQc80

[91] Willie Smits Interview for Asoka, http://www.youtube.com/watch?v=Gk9NUwxQc80;

identify those parts of the world.[92] Sugar palms can grow in areas that are greater than 4 degrees Celsius, with rainfall greater than 750mm per year, at an elevation less than 2,000 metres, with an infrastructure to bring out the sugar sap (50 kilometers from waterways or roads), with labor available, and income levels to make it economical for one household to produce five liters of ethanol per day in addition to other output.[93]

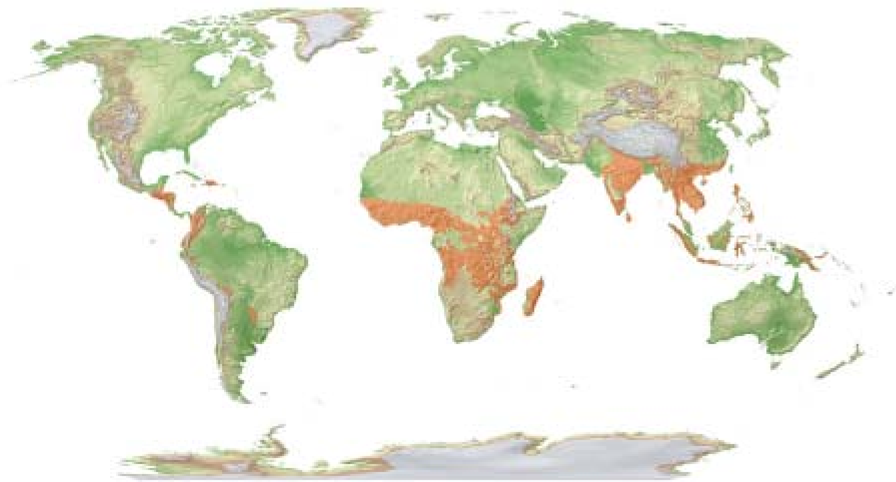

Figure 5. Areas Suited to Sugar Palm Growth[94]

CONCLUSION

Smits only occasionally uses the term "design" to describe his work in Samboja Lestari and Masarang. But the work he does, the results he achieves, and the process he employs all are a very good fit with the design approach to problem solving. His bottom-up approach to change successfully demonstrates how to balance what is technologically feasible, economically viable, and humanly desirable all the while adhering to the eight design principles—change oriented, holistic, integrative, collaborative, leader activated and orchestrated, research reliant but not research constrained, embodied learning, and action oriented.

FUTURE DIRECTIONS AND POLICY IMPLICATIONS

Can Smits' design approach to tackling our wicked problems be utilized elsewhere? A growing legion of social entrepreneurs is active worldwide, but we have yet to identify what principles and models of change agentry guide their activism. Systematic studies of their work and the
models of change that guide their problem solving might give us greater assurance in teaching design principles to others, assuming their results are similar to the Smits case. At this juncture, what we can say with assurance is that Willie Smits offers an excellent example of how to tackle some very wicked problems in Borneo. More studies are needed before we can say with any degree of confidence that wicked problems are no longer as difficult as we thought they were.

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[92] Willie Smits, Saving Rainforest http://poptech.org/popcasts/willie_smits_saving_rainforests; Sugar palm Ethanol, http://www.sugarpalmethanol.com/2010_06_01_archive.html

[93] Willie Smits, Saving Rainforest http://poptech.org/popcasts/willie_smits_saving_rainforests; Sugar palm Ethanol, http://www.sugarpalmethanol.com/2010_06_01_archive.html

[94] http://2.bp.blogspot.com/_QfNJGAl2TxU/TDrKQ44CBsI/AAAAAAAAEpE/OVRNhbJGTw8/s1600/arenga+suited+sectors.jpg; See also Willie Smits, Saving Rainforest http://poptech.org/popcasts/willie_smits_saving_rainforests;

In the meantime, we have learned some very valuable lessons from the Smits case that might inform other design projects. Three are particularly noteworthy. First, begin design projects from the bottom-up and "think with your hands." Design teaches us that context matters. Place is important and what works in one place may not work in another given its unique cultural heritage and physical characteristics. Only when prototypes are deemed successful in multiple local settings, only when we have identified the conditions for their success should we attempt their replication elsewhere. Smits' systematic build-out of the sugar palm experiments in Borneo and North Suawesi may hold promise for other areas of the world, but he understands their launch would require the same careful observation, data gathering, feedback, and adaptation to local conditions. Thus, design advocates would not choose to work in policy arenas and make policy recommendations until and unless they are ready—ready with data, ready with tested ideas and prototypes, ready with results that have demonstrable economic and social benefits. At the same time their bottom-up rather than top-down preference should not be construed as a lack of skill or interest. In Smits' case for example, there is every indication that he has crafted an extensive network of powerholders in Indonesia and around the world. Rather, his bottom-up push for change is an innate desire to retain a "feeling for the organism." It energizes his work and keeps him emotionally connected to the people he serves and the world he is attempting to save.

A second important lesson is that starting small and thinking with our hands from the bottom up is not to be confounded with the taming approach to wicked problems. Taming and bottom-up change have been confounded and it is important to distinguish between them. To tame a problem is to limit its complexity by removing those factors that create divisions and conflict in the problem solving space. Examples of taming include moving the problem off the decision agenda, minimizing the number of people who participate in problem solving, excluding data and ideas that don't support our own, or simply redefining the wicked problem to something easier to solve instead of one that is messy and conflict-ridden. In contrast, the design approach tackles wicked problems in all of their complexity as a whole system, but at different *scales* (Dust & Prokopoff, 2009). Rather than address deforestation on a grand scale worldwide, Smits began with what he knew about the land and the people in a small area of Borneo. Once he learned how the complex system of deforestation and its component parts were interrelated on a small scale (e.g. fires, floods, oil palms, pollution, soil degradation, species extinction), he then had insights about how the larger international system (e.g. international trade, government policy, and unbridled capitalism) fueled deforestation at the local level. All problem solvers face similar challenges. How should I define the system and its component parts? Where are the boundaries to the wicked problem territory? What level or scale makes sense given the problems I am confronting and the resources I have? Crafting answers to these questions makes design more of an art than a science but at least it enables the designer to begin the work. The key point to remember is that selecting a particular vantage point or scale from which to explore wicked problems as a system is not the same thing as attempting to tame a problem for political expediency, personal gain, or simply ease of management. The idea is to choose a scale that offers a way into wicked problem territory and enables exploration of wicked problems in all their attendant complexity. As Smits has demonstrated, the designer always has the option of moving into different levels or scales as learning and resources permit. The important point is to begin somewhere—best to do that at a level that is a good fit with the problem territory and the designer's knowledge, skills, and competencies.

And finally, if building a consensus is the crux of the issue with wicked problems, best to bring in others from the start rather than deal with their challenges and opposition downstream. Collaboration is essential in wicked problem territory and so is building a culture of design. Rather than "creating for people," design has become "creating with people" with the ultimate ideal of people "creating by themselves." The idea of "Everyman the Designer" is a compelling one says Tim Brown (2009, p. 59). But developing this mindset will take time, so designers need patience. Solutions in wicked problem territory are not short-term but require sustained effort over time. As Smits has demonstrated in his thirty years in Indonesia, wicked problems can be tackled—not easily, not quickly. But instead of being overwhelmed by complexity and immobilized by a stunned complacency, Smits is successfully confronting some of the worst wicked problems in Indonesia. His remarkable ability and progress have left us with one of the most important lessons of all—though his example we now have some reason for hope.

References

Ackoff, R. 1974. *Redesigning the Future*. New York/London: Wiley.

Ackoff, R. and Rovin, S. 2003. *Redesigning Society*. Palo Alto, CA: Stanford University Press. Argyris, C. and Schon, D. 1978. *Organizational Learning: A Theory of Action*. Boston: Addison-Wesley.

Batie, S.S. 2008. Wicked Problems and Applied Economics. American Journal of Agricultural Economics, 90(5):1176-1191.

Barber, C.V. and Schweithelm, J. *Trial By Fire: Forest Fires and Forestry Policy in Indonesia's Era of Crisis and Reform.* Washington D.C.: World Resources Institute.

Batie, S.S. and Schweikhardt, D.B. 2010. Societal Concerns as Wicked Problems: The Case of Trade Liberalization. *Proceedings.* OECD Workshop: Policy Response to Societal Concerns in Food and Agriculture. http://www.oecd.org/dataoecd/12/29/46837988.pdf

Blackman, T., Elliott, E., Greene, A. Harrington, B., Hunter, D.J., Marks, L., McKee, L., and Williams, G. Performance Assessment and Wicked Problems: The Case of Health Inequalities. 2006. *Public Policy and Administration*, 21(2):66-80.

Bornstein, D. 2007. *How to Change the World: Social Entrepreneurs and the Power of New Ideas.* Oxford: Oxford University Press.

Brown, T. 2009. *Change by Design.* New York: HarperCollins.

Brown, T. and Wyatt, J. 2010. Design Thinking for Social Innovation. *Stanford Social Innovation Review*, Winter, 31-35.

Brown, V.A., Harris, J.A., and Russell, J. Y. (Eds.). 2010. *Tackling Wicked Problems: Through the Transdisciplinary Perspective*. New York: Routledge.

Bryson, J.M. and Einsweiler, R.C. (eds). 1991. *Shared Power: What Is It? How Does It Work? How Can We Make It Work Better?* Lanham, MD: University Press of America.

Buchanan, R. 1992. Wicked Problems in Design Thinking. *Design Issues*, 8(2):5-21.

Camillus, J. 2008. Strategy as a Wicked Problem. *Harvard Business Review*, May:99-106. Chang, M. I. (ed.) 2011. *Pollution in China*. Hauppauge NY: Nova Science Pub Inc. Churchman, C. West. 1967. Wicked Problems, Guest Editorial, *Management Science*, 14(4):B141-B142.

Conklin, J. 2006. *Dialogue Mapping: Building Shared Understanding of Wicked Problems*. Hoboken, NJ: John Wiley and Sons Ltd.

Conklin, J. 2001. The Age of Design. http://cognexus.org/ageofdesign.pdf

DeGrace, P. and Stahl, L.H. 1990. *Wicked Problems, Righteous Solutions: A Catalogue of Modern Software Engineering Problems*. Englewood, NJ: Prentice Hall.

Dewey, J. 1958. *Experience and Nature*. Mineola, NY: Dover Publications.

Dewey, J. 1933. *How We Think.* New York: D.C. Heath.

Dust, R. and Prokopoff, I. 2009. Designing System at Scale. *Rotman Magazine*, Winter, pp. 53- 56.

Gastil, J. and Levine, P. (eds.) 2005. *The Deliberative Democracy Handbook*. San Francisco: Jossey-Bass.

Harrison, T. 2000. Urban Policy: Addressing Wicked Problems. In H.T.O. Davies, S.M Nutley, and P.C. Smith (Eds.) *What Works? Evidence-based Policy and Practice in Public Services.* Bristol: Policy Press, pp. 207-228.

Head, B. and Alford, J. 2008. Wicked Problems: The Implications for Public Management. Paper presented to the International Research Society for Public Management, 12th Annual Conference, 26-28 March, Brisbane.

Horn, R. E. and Weber, R.P. 2007. *New Tools for Resolving Wicked Problems.* http://www.strategykinetics.com/New_Tools_For_Resolving_Wicked_Problems.pdf

Hunter, B. 2007. Conspicuous Compassion and Wicked Problems: The Howard Government's National Emergency in Indigenous Affairs. *Agenda*, 14(3):35-54.

Issacs, W. 1999. *Dialogue: The Art of Thinking Together*. New York: Doubleday.

Kagan, R.A. 1991. Adversarial Legalism and American Government. *Journal of Policy Analysis and Management*, 10(3):369-406.

Kagan, R.A. 1998. Adversarial Legalism: Tamed or Still Wild? Journal of Legislation and Public Policy, 2:217-245.

Kreuter, M.W., De Rosa, C., Howze, E.H., and Baldwin, G.T. 2004. Understanding Wicked Problems: A Key to Advancing Environmental Health Promotion. *Health Education & Behavior,* 31(4):441-454.

Lach, D., Rayner, S. and Ingram, H. 2005. Taming the Waters: Strategies to Domesticate the Wicked Problems of Water Resource Management. *International Journal of Water*, 3(1):1-17.

Lane, R. and Woodman, G. 2000. Wicked Problems, Righteous Solutions: Back to the Future on Large Complex Projects. http://www.leanconstruction.org/pdf/RighteousSolution.pdf

Lazarus, R.J. 2009. Super Wicked Problems and Climate Change: Restraining the Present to Liberate the Future. *Cornell Law Review*, 94:1153-1234.

Levin, K., Cashore, B., Bernstein, S. and Auld, G. 2010. Playing it Forward: Path Dependency, Progressive Incrementalism, and the "Super Wicked" Problem of Global Climate Change.

http://environment.research.yale.edu/documents/downloads/0-9/2010_super_wicked_levin_cashore_bernstein_auld.pdf
Lewis, E. 1980. *Public Entrepreneurship: Toward a Theory of Bureaucratic Political Power*. Bloomington: Indiana University Press.
Leyman, J. 2001. *Command of the Seas.* Annapolis, MD: US Naval Institute Press.
Light, P. 2008. *The Search for Social Entrepreneurship*. Washington, D.C.: Brookings Institution Press.
Lindblom, C.E. 1959. The Science of Muddling Through. *Public Administration Review*, 21:78-88.
Little, J. B. 2008. Regrowing Borneo's Rainforest—Tree by Tree. *Scientific American*, 18:64- 71.
Johnson, N. F. (2007). *Two's Company, Three is Complexity: A simple guide to the science of all sciences*. Oxford: Oneworld.
Kellerman, E.F. 1983. *A Feeling for the Organism: The Life and Work of Barbara McClintock*. New York: Holt and Company.
Merton, R. K. 1936. The Unanticipated Consequences of Purposive Social Action. *American Sociological Review*, 1(6): 894-904.
Miller, J.H. and Page, S.E. 2007. *Complex Adaptive Systems: An Introduction to Computational Models of Social Life*. Princeton: Princeton University Press.
Nelson, H.G. and Stolterman, E. 2003. *The Design Way: Intentional Change in an Unpredictable World*. Englewood Cliffs, NJ: Educational Technology Publications.
Nerur, S. and Balijepally, V.G. 2007. Theoretical Reflections on Agile Development Methodologies. *Communication of the ACM*, 50(3):79-83.
Pacanowsky, M. 1995. TeamTools for Wicked Problems. *Organizational Dynamics*, 23(3):36- 52.
Page, S.E., Siegert, F. O'Rieley, J.O., Boehm, H.D-V., Jaya, A. and Limin, S. 2002. The Amount of Carbon Released from Peat and Forest Fires in Indonesia during 1997. *Nature*, 420:61-65.
Pfeffer, J. 1992. *Managing with Power: Politics and Influence in Organizations.* Watertown, MA: Harvard Business School Press.
Purser, R.E. and Griffin, T.J. 2008. Large Group Interventions: Whole System Approaches to Organizational Changes. Chapter 15. In T.G. Cummings (Ed.). *Handbook of Organization Development*. Thousand Oaks, CA: Sage.
Raisio, H. 2010. Embracing the Wickedness of Health Care. ACTA Wasaensia, No. 228. http://www.uwasa.fi/materiaali/pdf/isbn_978-952-476-316-5.pdf
Reich, R. (ed.) 1990. *Public Management in a Democratic Society*. Englewood Cliffs, NJ: Prentice Hall.
Rittel, H. and Noble, D. 1989. Issue-based Information Systems for Design. Working Paper 492, Berkeley, CA: The Institute of Urban and Regional Development, University of California.
Rittel, H. and Webber, M. 1973. Dilemmas in a General Theory of Planning. *Policy Sciences*, 4:155-169.
Roberts, N.C. Wicked Problems and Network Approaches to Resolution. *The International Public Management Review.*, Vol. 1, 1 (2000).
Roberts, N.C. 2002. The Calls for Dialogue. In N.C. Roberts (ed.) *The Transformative Power of Dialogue*. *Research in Public Policy Analysis and Management*, Vol. 12. London: JAI, pp. 3-24.
Schon, D. 1983. The Reflective Practitioner: How Professionals Think in Action. London: TempleSmith.
Scott, E. 1990. Managing Environmental Risks: The Case of ASARCO. In R.B. Reich, ed., *Public Management in a Democratic Society*. Englewood Cliffs, NJ: Prentice Hall.
Shiva, V. 1992. The *Violence of the Green Revolution*. London: Zed Books.
Simon, H. A. 1957. *Models of man: Social and Rational*. New York: Wiley
Thompson, S. 2010. Borneo Experiment Shows How Saving the Apes Could Save Ourselves. This Magazine, May 17. http://this.org/magazine/2010/05/17/apes-saving-humans/
Thompson, S. 2010. The Intimate Ape: *Orangutans and the Secret Life of a Vanishing Species*. New York: Citadel Press.
Tufte, E. 1990. Envisioning Information. Carol Stream, IL: Graphics Press.
Wang, S. 2002. Wicked Problems and Metaforestry: Is the Era of Management Over? The *Forestry Chronicle*, 78(4):505-510.
Wegner, J.W. 2009. Reframing Legal Education's "Wicked Problems." Symposium: A Legal Education Prospectus: Law Schools & Emerging Frontiers. *Rutgers Law Review*, 61(4):867-1008.
Whelton, M. and Ballard, G. 2002. Wicked Problems in Project Definition. *Proceedings of the International Group for Lean Construction,* 10th Annual Conference, Brazil. http://www.leanconstruction.org/pdf/WickedProblemsinProjectDefinitionIGLC10.pdf

ASSESSMENT OF TECHNOLOGICAL CAPABILITY IN THE INDIGENOUS OILFIELD SERVICING FIRMS IN NIGERIA

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Abstract
This paper assessed the factors that promote technological capability in the indigenous oilfield servicing firms in Nigeria. This was with a view to providing information that will increase indigenous participation in the sector and value addition for the nation. The study used primary and secondary data sources. Sixty firms were sampled. Structured questionnaire were administered in the firms. This was supplemented with shop-floor observations and interviews. The questionnaires elicited information on the firms' capability for innovation and the factors that influenced these. A total of 60 questionnaires were administered on heads of technical, finance and administration departments in the firms with 67% response rate. Secondary data were sourced from the internet and other publications. The data obtained were analysed using descriptive statistics. The important internal factors that accounted for the firms' technological capability (TC) included the qualifications and experience of the heads of technical departments and extensive staff training. The exogenous factors included interaction with customers, competitors, suppliers of equipment and the trade association. In conclusion, the most significant driver of TC building in the firms was the trade association.

Keywords: Local content, Oil and Gas industry, Technological Capability, Innovation

Introduction

The Oil and Gas Industry (OGI) in Nigeria plays a crucial role to the sustenance of the nation and fuels her economic and development activities. The industry has been widely described as the nation’s live wire and literature abounds on its role and significance in Nigeria (Agusto, 2002; Atakpu, 2007; Odulari, 2008). Nonetheless, an estimated $8 billion is spent annually on servicing the industry in operations such as fabrication, engineering, procurement, and construction (EPC), front end engineering design (FEED), conceptual designs and seismic studies. This figure is projected to hit $15 billion within the next few years (Business Day, 2008). Regrettably, despite these huge sums of money spent in servicing the industry, only a very little proportion of the accruable profit is spent in Nigeria. Majority of the amounts are repatriated abroad, where most of the equipments are manufactured; and providing employment opportunities for citizens of other countries. The major reason for this situation has been attributed to low local content (LC), which is a situation where most of the service contracts are awarded to foreign firms because indigenous firms lack the requisite skills, technical expertise, manpower and production capacity and capability to compete favourably. Oladele (2001) posited summarily attributed the low LC in the Nigerian OGI to insufficient capital, poor training, and low corporate image. Aneke (2002) and Heum et al. (2003) expanded the above reasons for low local content in Nigeria to include: low technological capacity; lack of funding from financial institutions; inadequate and incoherent policies/legislations; inadequate infrastructure; unfavourable business climate; lack of partnering between indigenous contractors and technically competent foreign companies. This paper zeros in on technological capability as an indispensable asset for the OGI in Nigeria.

Technological capability is defined as the resources needed to generate and manage production-based and innovative activities such as improvements in processes and production organisation, products, equipment, and engineering projects (Figueiredo, 2007). These are accumulated and embodied in individuals (skills, expertise and experience) and orgainstional routines and systems. The authors in this paper seek to examine the factors that contribute to the development of TC as a resource in the Nigeria OGI.

Since the last five decades, the Nigerian Oil and Gas Industry have continued to play a key role in the country's economic growth and development. The sector generates about 95 percent of total export revenue and 80 percent of her total national income. In addition, it expends about $8 billion annually in servicing its operations. Sadly, a significant proportion of this amount is paid to foreign contractors for services like fabrication and engineering procurement; resulting into capital flight and leaving very little to developing the country's industrial base. Similarly, the 'Local Content' (LC) policy, aimed at championing the course for higher indigenous participation in the sector and value addition for the nation have not been implemented cause the indigenous firms lack the required technological capability.

Literature Review

Two areas of research viz technological capability and technological learning are pertinent to this study and are hereby discussed.

Technological capability

According to the most widespread and accepted concepts in literature; (Prahalad and Hamel, 1990; Grant, 1991; Black and Boal, 1994; Christensen, 1996; Miller and Shamsie, 1996; Wiklund and Shepherd, 2003), García-Muiña and Navas-López (2007) strategic technological capability is defined as the generic knowledge and ability to jointly mobilise different scientific and technical resources which enables a firm to successfully develop its innovative products and/or productive processes, by implementing competitive strategy and creating value in a given environment. The concept of technological capabilities is one that is central to the quest for development among the least developed, developing and transition economies. It is also critical in the drive towards sustained leadership among the countries at the forefront of technological growth. It is generally agreed in the literature on growth and competitiveness that a country needs technological capabilities before it can grow sustainably; and that it acquires this primarily through learning (Garvin, 1981; Cohen and Levinthal, 1989; Malerba, 1992; Dodgson, 1993; UNCTAD, 1996; Lall, 1992). Thus, we may describe technological capabilities as the resources that are organised to generate innovations, which may be incremental or radical.

Wangwe (1995) had opined that the level and depth of a country's technological capabilities affect its industrial performance; and that technological capability also augments the firms' competitiveness in export markets in two ways: by enabling the firm to utilise the current stock of its resources more effectively or efficiently and by permitting a firm to advance more rapidly its mastery of technology. Along this line, he defined these capabilities as the skills — technical, managerial or organisational — that enable firms to efficiently use equipment and information, and improve technology. At the national level, these capabilities exist in physical investment, human capital and national technological efforts (Lall, 1992). Enos (1991), with particular reference to developing countries, defined technological capability, at the national level, as something that enables a developing country to exploit existing techniques fully and, ideally, to improve upon them.

At both the firm and national levels, technological capability has been variously defined in three broad ways: as input to economic activities (Aw and Batra, 1998), as output of economic activities (Girvan, 1981; Enos, 1991) and as both an input and output (Lall, 1994; Bell and Pavitt, 1997). In this context, technological capability may then be considered as an input into other economic activities this include informed choices on technologies that could contribute to the country or firms development goals. As an output, Girvan (1981) and Enos (1992) define technological capability in terms of a complex mix of people with scientific training in a particular area of concern, people with a certain amount of operational experience; and organisations in which the skills are resident with potentials to use them for actualisation of certain goals. For the purpose of this study, Aw's and Batra's (1998) definition comes close to giving a perfect conceptualisation. With a particular focus on developing countries as importers of technologies, they described technological capability as the ability to adapt or assimilate imported technology and to incorporate the additional and distinct resources needed to manage and productively use the newly acquired technology. However, given that developing countries do not only import technologies (Bell and Pavit 1993), Lall *et al* (1993) offer a more robust description of technological capability as the resources needed to generate and manage technical change. These resources, according to them, include skills, knowledge, experience as well as particular kinds of institutional configurations (that is, structure and linkages) necessary to produce inputs for technical change. Apparently harmonising these two perspectives, Lall (1994) conceptualised technological capability as critical "assets" - human and organisational capital – that is employed by productive enterprises for the efficient use of machinery, equipment and technologies.

Thus, technological capability, especially as it affects the developing economies, means more than the conventional triad of science, engineering and technology. It includes organisational know-how, and knowledge of how workers, suppliers and customers behave as well as the reasons behind these (Black and Boal, 1994). These knowledge and skills are developed over time from iterative trial and error; cumulative learning by doing and by using; and by interactions within a firm, between a firm and its suppliers and between a firm and its customers (Olamade, 2001).

Technological Learning

Indeed, it is now known that the successful adoption of technology is not a plug-and-play exercise; it involves, for instance, more than merely the purchase of machinery and the learning of operating procedures (Dahlman and Westphal, 1982). This is due, in part, to the generally tacit and dynamic nature of technological knowledge, making it difficult or very costly to effectively communicate the full range of skills and knowledge required for executing complex tasks. As such, firms must make conscious efforts to improve their productivity (Lall, 1992), and invest time before being able to operate any particular technique at optimal efficiency. What this implies for firms in the developing world is that, while technology "transfers" may be necessary, they are not sufficient. The effective adoption and mastery of a technology requires the acquisition of knowledge about a set of procedures, understanding of why the procedures work and skill in putting them to use. It also involves, according to Bell and Pavitt (1993), the adaptation of a technology to meet specific situational needs and continuous incremental modifications to improve the technology.

Thus, firms are required, more often than not, to invest time and conscious efforts in the development of relevant capabilities. As a matter of fact, technological development - the building of the broad range of technological capabilities (Lall *et al*., 1993) - is acquired by a technological learning process. Learning results in technological capability - knowledge and skills needed for firms to choose, install, operate, maintain, adapt, improve and develop technologies. Dodgson (1993) described technological learning as the way "firms build, supplement and organise knowledge and routines around their activities and within their culture and adapt and develop organisational efficiency by improving the use of the broad skills of their workforce". An important caveat was however given by Huber (1991) when he stated that the process of technological learning is not necessarily conscious or intentional. At the firm level, Wangwe (1995) divided the factors influencing industrial technology development into three groups: the incentive framework (the demand side, largely originating from the macroeconomic environment and conditions in the major markets, such as their growth prospects), the supply factors (skills, finance, and information), and institutions (the organisations set up to support the functioning of the supply factors). Nonetheless, a firm would still require certain capabilities for learning. Jin and Stough (1998) define the learning capability of an agent as its capacity to create, acquire, and transform knowledge and thereby upgrade its skills, expertise and competencies.

There are three types of learning. Formal learning leads to certificates, diplomas and degree. Non-formal learning, such as on-the-job training, collaboration or learning externalities, takes place either within or outside the firm. Informal training is a life-long process by which employees in foreign affiliates or in domestic companies interact with Trans-National Corporations (TNCs) and acquire values, attitudes and beliefs embedded in the organisational culture of the TNCs through daily experience, observation and exposure to indoctrination. According to Biggs *et al* (1995) and Wangwe (1995), technological learning is facilitated by firms' involvement in an information-rich environment created by a dense network of relations with other firms engaged in similar activities with training opportunities and information sources that address specific business problems and with an available network of specialised consultants. Technological learning and the strategy for approaching it therefore becomes crucial for firms that have to operate imported technology. Since industrial dynamism and competitiveness depend largely on the accumulation of technological capabilities, Bell and Pavit (1993) refers to any process that strengthens those capabilities as technological learning.

Following from the foregoing discourse, it can be said that technological capabilities in developing countries generally differ from those in the developed world because technologies are often imported. This holds a two-fold implication for the firms in developing countries. First, local firms must be able to assimilate, adapt and improve the imported technologies if they must benefit from them. Second, the insufficient supplies of human capital, advanced machinery and technological knowledge often found in developing countries must be compensated for through deliberate in-house efforts. Thus, while firms may be induced to develop technological capabilities and exert appropriate efforts through international trade and domestic competition policies; they must still rely on existing capabilities, such as skills, technology, finance and infrastructure. For instance, a firm may not be able to compete even in the local market with cheaper imports unless it has developed a solid base of local skills and its own technological efforts. This is particularly relevant to this study in that the technologies used in the oil and gas servicing firms are imported. However, we seek to investigate how learning has transpired in the sub-sector through deliberate in-house efforts and how much of these have precipitated into innovation and value addition for the nation.

Methodology

The main analytical concepts and the relationships in this study is based on what has been established in literature on technological capabilities with a little modification on work of Romijn and Albaladejo, (2002) and Egbetokun *et al* (2007) who in their study of the 'determinants of innovation capability in small high-tech firms in the United Kingdom (UK)' and 'assessment of innovation capability in the cable manufacturing industry in Nigeria' respectively found that capabilities accumulate as a result of various internal and external inputs.

This study focused on the indigenous oilfield services firms. The firms were purposefully selected. Data was collected from the firms through the use of a structured questionnaire. The questionnaires were administered on two departments identified as relevant to this study (Production and Engineering/Maintenance). Forty questionnaires were administered to the firms. The questionnaire elicited information on the innovation strategies of the firm, its human resource, innovation rate and expenditure on R&D as well as the incidence of collaboration/joint activities with stakeholders within the National Innovation System (NIS). The questionnaire, which is for the Production Department and Engineering Department, covers the innovation and technological efforts of the firms; their sources of information for innovation as well as the nature of linkages and interactions in the industry.

Previously tested questionnaires such as the African template proposed by UNU-INTECH (2004), the revised questionnaire employed in the South African Innovation Survey 2007 (Oerlemans *et al*., 2007) and the list of variables used by Romijn and Albaladejo (2002), in their study on the determinants of innovation capability in UK SMEs was adopted for this study.

Results and Discussion

The main internal sources of technology capability evaluated in this study are the background of the head(s) of technical departments in the firm and the internal technological efforts of the firm (staff training and innovation expenditure).

Background of the head(s) of technical department(s)

The study noted that only 11 out of 40 have separate production and engineering departments while the remaining 29 have the production and engineering department as one single department

Production department

The result of this study showed that 52.5 % of the heads of production department in the firms surveyed have Higher National Diploma, while 20% have Bachelors Degrees, 22.5% have Masters Degree and 5% have Doctorate Degree. Also, 80% of the heads of production department have degrees in Science or Engineering field while 20% have degrees in Management or Finance-related field. Furthermore, 7.5% of the heads of technical department went for training in other African countries, 20% in Europe, 7.5% in South America, 15% in Asia and 5% in Australia at some point in time. As to where their degrees were obtained, 2.5% of the head of the production department obtained a degree in other African countries, 15% obtained degree in Europe, and 2.5% obtained degree in United States, Canada or Mexico.

Engineering department

Information gathered from this study showed that 42.5% of the heads of engineering department have Higher National Diploma, while 30% have Bachelor Degrees, 20% have Masters Degree and 7.5% have Doctorate Degree. Those who obtained degrees in Finance-related field were 77.5%. Also, 15% of the heads of engineering department went for training in other African Countries, 12.5% in Europe, 15% in United States, Canada or Mexico, 5% in South America, 12.5% in Asia and 2.5% in Australia at some point in time. While 10% of the heads of the engineering department obtained a degree in Europe, 2.5% in United States, Canada or Mexico while 2.5% of the heads of the engineering department had previously worked in other African Countries.

Types of Technological Innovations

The table below shows the types of technological innovations that had taken place in the indigenous oilfield services firms in Nigeria between 2007 and 2010.

Table one: Types of technological innovations in the indigenous oilfield services firms

	Types of Technological Innovation	Completed (%)	Started but later abandoned (%)	Never initiated (%)
Product Innovation	Introduced new product	12.5	2.5	85
	Developed new product	2.6	5.1	92.3
	Improved existing product	5.1	0	94.9
Process Innovation	Introduced new process	12.8	5.1	82.1
	Developed new process	2.6	10.3	87.2
	Improved existing process	23.1	5.1	71.8
Organisational Innovation	Introduced quality Control	42.5	7.5	50
	Introduced maintenance routine	55	10	35
	Introduced waste management procedure	37.5	15	47.5
	Reverse engineered any product/process	10.3	28.2	61.5

Source: field survey, 2011

The prevalence of organisational innovations was observed to be higher than that of all other innovation types (Table one). It was the only type of innovation that ranked high. This primarily suggests that organisational changes are at the heart of the innovation processes in the indigenous oilfield servicing sub-sector. These changes, like OECD (2005) argued, are typically expressed in business practices and workplace organisation that are new to the firm and occur as a result of strategic management decisions. The intensive prevalence of organisational innovation, alongside process innovation, within our developing country context is not surprising because organisational changes, very much like process innovations, are less risky and consume much less resources compared to other types of innovations. Concerning process innovation, Egbetokun *et al*. (2009) noted that changes in processes are less rigid, more responsive to 'shop-floor' serendipitous discoveries and may not generally require financial investments as much as product innovations.

Diffusion-Based Innovation

The study showed that 41% (16) of the firms developed/applied some new or modified versions of any of either product or process technology within the period 2007 and 2010. Of these 16 firms, 31.2% (5) firms developed the new or modified versions of product or process which they have a license on their own while 62.5% (10) of the firms developed or modified through partnership with the licensor. The 41% incidence of diffusion-based innovation recorded in this study actually arose from product and process licences. This somewhat low figure is a true representation of the situation within the sub-sector. The firms in the industry are all SMEs that are mostly confronted by several resource constraints. It is therefore difficult for them to procure licences. Low levels of absorptive capacities may also explain this situation (Audretsch *et al*, 2005; Rosa and Mohnen, 2008). The firms that have been able to do this are those which with Foreign-based corporation affiliation.

Table two: patents the selected firms applied for and the amount granted in the period 2007-2010

No of patent application	**Percentage Respondent**	**No of patent Granted**	**Percentage Respondent**
0	53.3	0	83.3
1	33.3	1	16.7
2	3.4	2	0
Total	**100**		**100**

Source: field survey, 2011

The table above shows that the firms have not really invented new technologies on their own as only one patent was granted to the firms within the study period.

Trainings and technological learning

The fact that firms require an adequate stock of skilled manpower and the role played by firm-level investments in training to enhance this pool has been established in the innovation literature (Romijn and Albaladejo, 2002; Amara *et al*., 2008). More recent research has indeed proven that firms that continually invest in staff training tend to be more capable to innovate.

Table three: Nature of training embarked upon by the firms within the period 2007 to 2010

	2007	2008	2009	2010
Use of Information & Communication Technology	3 (7.5%)	4 (10%)	7 (17.5%)	7 (17.5%)
Repairs and Maintenance	1 (2.5%)	5 (12.5%)	12 (30%)	10 (25%)
Project Management	1 (2.5%)	2 (5%)	12 (30%)	14 (35%)
Technical Report Writing	0	1 (2.5%)	4 (10%)	2 (5%)
Industrial Safety	2 (5%)	4 (10%)	8 (210%)	8 (20%)

Source: field survey, 2011

The fact that firms require an adequate stock of skilled manpower and the role played by firm-level investments in training in enhancing this pool has been established in the innovation literature (Romijn and Albaladejo, 2002). The results in Table three showed that that the indigenous oilfield servicing firms in Nigeria were marginally active in this regard as all of the firms reported having implemented one or more staff training programmes within the period covered in this study.

Training and Innovation Expenditure

The training and innovation expenditure of the firms is given in table four below

Table Four: Training and innovation expenditure of the Firms

Expenditure (Million Naira)	2007 (%)	2008 (%)	2009 (%)	2010 (%)
Training				
Less than 1	10	12.5	17.5	17.5
Between 1 and 5	5	12.2	32.5	35
Between 5 and 10	Nil	Nil	Nil	5
Innovation				
Less than 1	12.5	12.5	12.5	12.5
Between 1 and 5	5	12.5	12.5	15
Between 5 and 10	Nil	Nil	Nil	2.5

Source: field survey, 2011

Majority of the firms that engaged in staff training spent below a million naira per year but the trend became reversed as the years progressed (table four above). Like the training expenditure, the innovation expenditure increased as the years progressed.

Interactions within the Oilfield Services Sectoral Innovation System

This study also considered networking and collaboration as well as the advantages that firms might derive from these when they are located close to the actors involved in these networks. Several previous studies (Meeus *et al*., 1999a, 1999b; Romijn and Albaldejo, 2002) have highlighted the importance of a number of stakeholders within an innovation system that firms may network or collaborate with. Evidences exist in favour of customers, suppliers, industry associations, higher education and research institutions, among others as helpful sources of information for the firms' innovation activities. Table five shows that the firms interacted more with their trade association than with most other actors. Egbetokun *et al*., (2009) found that the most highly rated source of information for innovation were customers. Jaruzelski and Dehoff (2007) also showed that customers probably matter more than any stakeholder in innovation. Interaction with competitors and Training Institutions were also relatively high as 65% of the sampled firms collaborated with each of these stakeholders during the period covered by this study.

All the firms are subcontracting for the Oil and Gas companies. As it is, 74.4% of the oilfield services firms outsource to other oilfield services firms.

Table five: Intensity of the interactions between the elements of Nigeria's Petroleum National Innovation System

	Firms involved in interactions (%)	Firms that benefitted from interactions (%)
Competitors	80.6	75.5
Customers	65.4	61.8
Suppliers	70.4	64.7
Associated Companies	40	40.6
Consulting and Marketing firms	13.6	21.9
Private Research Institutes	13.6	16.7
Public Research Institutes	18.2	13.3
Universities	38.5	36.4
Government Ministries	5	6.9
Financial Institutions	28	29
Training Institutions	69	67.6
Trade Association	94.3	92.1

Source: field survey, 2011

In contrast with the general trend in the literature (Autant-Bernard and Massard 2007;UNU-INTECH, 2004; Audretsch *et al*., 2005; Rosa and Mohnen, 2008), the occurrence of proximity of knowledge centres among the firms was very low except for the Training Institutions (Table five above). This is in spite of the fact that all the firms are located in the same city with at least a university. Perhaps this could be explained by the general economic paradigm that firms require a certain level of absorptive capacities (usually approximated by firms' proportion of R&D staff, engineers or scientists) to be able to assimilate scientific knowledge and to benefit optimally from partnerships with knowledge centres, especially universities (Cohen and Levinthal, 1990; Fontana *et al*., 2006; Rosa and Mohnen, 2008). Although it was difficult to empirically evaluate the firms' absorptive capacity because data gathered on staff profiles were largely partial and unreliable, the information gathered from the interviews conducted pointed out that the absorptive capacities of the firms in the indigenous oilfield servicing sub-sector was quite low. For instance, in few of the firms, apart from the CEO and his heads of technical departments, every other staff had less than a university degree. Within the production department in those firms, nearly every worker was employed with secondary or vocational qualifications and then trained on the shop floor. In some firms, we found about 75% of employees having either secondary school or vocational qualifications. Proportion of engineers and scientists in the firms' total workforce was 15% while the proportion of technicians was 10%.

On the other hand, majority of the firms admitted that close location to suppliers, competitors (80.6%), customers (65.4%), training institutions (69%) and particularly industry associations (94.3%) had been very beneficial to them (Table five). This seems to suggest that it could have been easier for the firms to explore and seize the advantages from being close to these actors since no considerable level of absorptive capacity is required. An implication that could be drawn from the foregoing discussion is that in facilitating industry-academic relations, both proximity and firm-level absorptive capacities are critical and require attention from all stakeholders.

Government support

Previous studies have shown that major government S&T policies and programmes may have more impact on innovation than the activities and strategies of private enterprises (OECD, 2005). Thus, the role of government as an institution is critical for firm-level innovation. Such roles typically include the design and implementation of innovation-friendly policies, effective monitoring of these policies, procuring innovative products from domestic firms and creating a stable political and economic ambience, among others. In table six, 2.6% of the selected firms enjoyed support from the Nigerian government within the period 2007 to 2010 while the remaining 97.4% did not benefit from of government support within the said period. However, 33.3% of the selected firms claimed to be aware of some government policies that support innovation.

Perhaps even more striking is the fact that the firms have apparently not collaborated extensively or gained proximity advantages from government organisations such as public research institutes and government ministries. Only 6.9% of the firms have collaborated with government ministries and 5% indicated having gained proximity advantages from these. Also, 13.3% have collaborated with public research institutes while 18.3% indicated having gained advantages from the collaboration. While the latter is understandable considering that the firms were not so closely located to the ministries, the dearth of collaborative activities of the firms with government organisations seems to suggest that the government organisations have not been adequately supportive.

Table six: Advantages the firms benefited from government

	R&D funding (%)	Training (%)	Subsidies (%)	Tax Rebate (%)	Technical Support (%)	Loans and Grants (%)
Not Important	7.5	5	0	0	2.5	10
Slightly Important	7.5	10	5	0	7.5	2.5
Important	0	0	7.5	17.5	5	5
Very Important	5	5	20	20	12.5	2.5
Total	20	20	32.5	37.5	27.5	20
Missing	80	80	67.5	62.5	72.5	80

Source: field survey, 2011

The table above reveals that the firms have not really benefited from government support and policies in the study period. There is need for government to formulated new policies that would support the growth of small and medium scale enterprises.

Conclusion

The results showed that the firms demonstrated some level of technological capabilities and innovation, albeit in an uneven manner. Although some product, process and diffusion-based innovation were found, organisational innovations were at the heart of the innovation activities of the firms. In addition, it was found that these firms operate within a weak Oilfield Sectoral Innovation System (SIS). It is to be concluded from these that firms operating within such contexts are not necessarily innovation-inactive.

The results also indicate that trade associations have a central role to play in facilitating firm-level innovation especially in the developing country context. Few earlier studies have identified such associations as important in the processes that lead to the build-up of firm-level capabilities through the knowledge available on the specific roles that they are capable of playing is still very sparse. Obviously, their roles now transcend mere activism and protection of rights but also involve covering resource deficiencies for member firms, helping member firms learn and creating access to innovation-friendly support.

Firms were seen not to have received much support from knowledge centres and even from government. Specifically, diffusion-based innovation was very low. The few firms that succeeded in doing this were those that on their own had significant external resource endowments by virtue of belonging to a global group or creating international ties. Most of the firms were largely unable to muster enough resources on their own to engage in activities that would give rise to that kind of innovation. Thus, stronger government-finance-research-industry linkages that would ease resource deficiencies are critical to firm-level innovativeness.

Implication of the study

For the firms, the following specific suggestions are useful for the build-up of innovation capability:

i. Interactions among the key actors in the innovation system matter so much as far as firm-level innovation is concerned. Firms should therefore make efforts to form more of these. Attention should be paid to interactions that are most beneficial to the actors.
ii. Although the trade association has already been very supportive, its effect could be more pronounced at the firm-level if the technical committee were made to visit the shop floor more regular and, to some extent, impromptu. In a sense, this would discourage window-dressing among the member firms.
iii. On firm-level leadership, our findings imply that the possession of a university degree and previous work experience in an SME by the heads of department of an SME is very useful.
iv. On individual level, firms are required to improve their absorptive capacities by creating regular programmes for staff development, and making the necessary investments.

References

Agusto, O. (2002). Industry Report- Oil and Gas (Upstream) conducted by Agusto & Co. Limited, April.

Aneke, P. (2002). The role of major operators in the development of local content in the Nigerian oil and gas industry. A paper delivered during a national seminar on the dynamics of equipment leasing and contract financing for local contractors in the oil and gas sector, Port Harcourt, Nigeria.

Atakpu, L. (2007). Resource-based conflicts: Challenges of Oil Extraction in Nigeria; paper presented at the European Conference hosted by the German EU Council Presidency (March 29 and 30), Berlin, Germany.

Audretsch, D.B., Lehmann E.E. and Warning S. (2005).“University Spillovers and new Firm Location“, Research Policy 34, 1113-1122.

Autant-Bernard, C. and Massard N. (2007). – “The Geography of Knowledge Spillovers and Technological Proximity”, in M. Feldman and Massard N., Institutions and Systems in the Geography of Innovation, Kluwer Academic Publishers Group, the Netherlands.

Aw, B. Y. and Batra G. (1998) ‘Technological Capability and Firm Efficiency in Taiwan (China)’ The World Bank Economic Review.

Bell, M. and Pavitt K. (1993) “Accumulating Technological Capability in Developing Countries” Proceedings of the World Bank Annual Conference on Development Economics 1992. Washington: IBRD (The World Bank).

Bell, M. and Pavitt, K. (1997), Technological accumulation and industrial growth: contrasts between developed and developing countries. In: Archibugi D. and Michie J. (eds),

Biggs, T, Shah, M, Strivastava, P. (1995) ‘Technological Capabilities and Learning in Africa Enterprises’ World Bank Technical Paper No.288 Washington, D.C.

Black, J.A., Boal, K.B., 1994. Strategic resources: traits, configurations and paths to sustainable competitive advantage. Strategic Management Journal **15**, pp. 131–148.

(B.P. Statistical Energy Survey, (2008). Available on internet at http://www.mbendi.com/indy/oilg/af/ng/p0005.htm accessed on 17th January, 2011)

Christensen, J.F., 1996. Analysing the technology base of the firm: a ‘‘multi-dimensional resource and competence perspective. In: Foss, N.J., Knudsen, C. (Eds.), Towards a Competence Theory of the Firm. Routledge, London, pp. 111–132.

Cohen, W.M. and Levinthal, D.A. (1990). **“**Absorptive Capacity: A New Perspective on Learning and Innovation”, Administrative Science Quarterly 35, 128-152

Cohen, W.M. and Levinthal, D.A., 1989. Innovation and learning: the two faces of R&D. The Economic Journal 99, 569–596.

Dahlman, C. and Westphal, L. (1982) 'Technological Effort in industrial development: a survey', in Stewart F. and James J. (eds), The Economics of New Technology in Developing Countries, London: Pinter

DeCarolis, D.M., (2003). Competences and imitability in the pharmaceutical industry: an analysis of their relationship with firm performance. Journal of Management 29, 27–50.

Dodgson, M. (1993) ‘Organisational Learning: a Review of Some Literatures’ Organisational Studies Vol. 14, No3.

Egbetokun, A. A., Siyanbola, W. O. and Adeniyi, A. A. (2007). Assessment of Innovation Capability in the Cable and Wire Manufacturing Industry in Nigeria: a case study approach. Paper presented at the Micro Evidence on Innovation in developing Economies[MEIDE], May 31 – June 1, 2007, UNU-MERIT, Maastricht, the Netherlands. Available online at: http://www.merit.unu.edu/MEIDE/papers/2007/EGBETOKUN_SIYANBOLA_ADENIYI_Assessment%20of%20innovation%20capability...cable%20and%20wire%20manufacturing%20industry.pdf [accessed 19 July 2007].

Egbetokun, A.A., Siyanbola, W.O., Sanni, M., Olamade, O.O., Adeniyi, A.A. and Irefin, I.A. (2009) ‘What drives innovation? Inferences from an industrywide survey in Nigeria’, Int. J. Technology Management, Vol 45, Nos. 1/2, pp 123-140..

Enos, J. L. (1991) The Creation of Technological Capability in Developing Countries. London. Pinter’s Publishers.

Figueiredo, (2007). Technological learning and innovation in developing countries. Available at www.inderscience.com/www.newsletter/2007/article_autumn2007.pdf

Fontana, R., Geuna, A. and Matt, M. (2006). “Factors affecting university-industry R&D projects: The importance of searching, screening and signaling”, Research Policy 35,309-323

García-Muiña, Fernando E. and Navas-López, José E. (2007) Explaining and measuring success in new business: The effect of technological capabilities on firm results. Technovation, **27** (2007) pp30–46

Girvan, N. (1981) ‘Note on Technological Capability’ Research Paper Series No 1, Department of Economics, University of West Indies (St Augustine, Trinidad and Tobago).

Grant, R.M., 1991. The resource-based theory of competitive advantage: implications for strategy formulation. California Management Review 34, 114–135.

Heum, P., Quale, C., Karlsen, J. E., Kragha, M. and Osahon G., (2003). Enhancement of Local Content in the Upstream Oil and Gas industry in Nigeria: A comprehensive and viable policy approach; joint study by

SNF-Institute for Research in Economics and Business Administration, Bergen, Norway SNF Report No. 25/03(August).

Huber, G. (1991). Organizational learning: the contributing processes and literature. Organisation Science, **2**, pp. 88-115.

Jaruzelski, B. and Dehoff, K. (2007) The Customer Connection: The Global Innovation 1000, Booz Allen Hamilton Inc.

Jin, D.J. and Stough, R.R. (1998). Learning and learning capability in the Fordist and post-Fordist age: an integrative framework. Environment and Planning A, 30, pp. 1255-1278.

Lall S. (1992). Technological capabilities and industrialization. World Development 20(2), 165-186

Lall, S., Navaretti, G.B., Teitel, S. and Wignaraja. G (1993). Technological Capabilities and Industrial Development in Ghana. Study prepared for the World Bank, Washington, D.C.,

Lall, S. (1994) 'The East Asia Miracle Study: Does the Bell Toll for Industrial Strategy?' World Development 22(4).

Malerba, F., 1992. Learning by firms and incremental technical change. The Economic Journal 102, 845–859.

Meeus, Marius T.H., Oerlemans, Leon A.G. and Van D., Jules J.J. (1999a). Regional systems of innovation from within: An empirical specification of the relation between technological dynamics and interaction between multiple actors in a Dutch region. Eindhoven Centre for Innovation Studies (ECIS) Working Paper 99.1,ECIS, The Netherlands

Meeus, Marius T.H., Oerlemans, Leon A.G. and Hage, Jerald (1999b). Sectoral Patterns of Interactive Learning: An empirical exploration using an extented resource based model. Eindhoven Centre for Innovation Studies (ECIS) Working Paper 99.5, ECIS, The Netherlands

Miller, D., Shamsie, J., 1996. The resource-based view of the firm in two environments: the Hollywood films studios from 1936 to 1965. Academy of Management Journal 39, 519–543.

Organisation for Economic Cooperation and Development (OECD) (2005). Proposed guidelines for collecting and interpreting technological innovation data: Oslo Manual, 3rd ed. OECD. Paris.

Oerlemans, L.A.G., Meeus, M.T.H., Boekema, F.W.M., 1998. Learning, innovation and proximity. Working Paper 98/3, Eindhoven Centre for Innovation Studies, Eindhoven University of Technology, Eindhoven.

Odulari, G. O. (2008). Crude Oil and the Nigerian Economic Performance. Oil and Gas Business. (http://www.ogbus.ru/eng/).

Oladele, O. R. (2001). "Opportunities for Indigenous Participation." Paper presented at the NNPC Workshop on Improvement of Local Content.

Olamade, O. O. (2001). Technological Capabilities in the Nigerian Telecommunications Industry. A Thesis submitted to the Technology Planning and Development Unit, Obafemi Awolowo University, Ile-Ife, in partial fulfilment of the requirements for the award of the degree of MSc. (Technology Management).

Pietrobelli C. (2006). Fostering technological capabilities in sub-Saharan Africa. Science and Development Network (SciDev.Net) Policy Briefs, November, 2006 (available online at http://www.scidev.net...

Prahalad, C.K., Hamel, G., 1990. The core competence of the corporation. Harvard Business Review May/June, 79–91.

Romijn, H. and Albaladejo, M. (2002). Determinants of innovation capability in small electronics and software firms in southeast England. Research Policy 31 (2002) 1053–1067.

Rosa, J. and Mohnen, M (2008). Knowledge Transfers between Canadian Business Enterprises and Universities: Does Distance Matter? UNU-MERIT Working Paper # 2008-17. Available at http://www.merit.unu.edu/publications/wppdf/2008/wp2008-017.pdf (Accessed March 21, 2008).

United Nations University Institute for New Technologies (UNU-INTECH) (2004). Designing a Policy-Relevant Innovation Survey for NEPAD, mimeo: A Study prepared by UNU-INTECH, Maastricht, The Netherlands.

United Nations Conference on Trade and Development (UNCTAD). (2007). The TRIPS Agreement and Developing Countries.Geneva.

Wangwe, S. M. (ed.) (1995) Exporting Africa: technology, trade and industrialization in Sub-Saharan Africa. UNU/INTECH, London and New York.

Wiklund, J., Shepherd, D., 2003. Knowledge-based resources, entrepreneurial orientation, and the performance of small and medium-sized business. Strategic Management Journal 24, 1307–1314.

TRIPLE HELIX COLLABORATION TO DEVELOP ECONOMIC CORRIDORS AS KNOWLEDGE HUB IN INDONESIA

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Abstract
The paper aims to analyze the capabilities of triple helix actor (academician, local business and local government) and propose model of collaboration to develop Indonesia economic corridors in MP3EI as knowledge hub. A range of relevant literatures and secondary data are explored to propose and discuss a conceptual model in this study. The result will become a useful foundation model for the future research of knowledge hub development in a knowledge based-economy. The empirical findings of this study can be used by each triple helix model's actors as a guidance to develop knowledge hubs in each economic corridor in Indonesia.

Keywords: Triple Helix Collaboration; Master Plan Acceleration and Expansion of Indonesia Economic Development (MP3EI); Economic Corridor; Knowledge-based Economy; Indonesia.

ENHANCING GREEN SUPPLY CHAIN PRACTICES IN INDONESIA: AN ABG (ACADEMICS-BUSINESSES-GOVERNMENT) COLLABORATION

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Abstract
Supply chain management can be defined as any activities involved in planning, organizing, directing, and controlling of flows of materials, information, and capital or money. Practices of supply chain management involve collaboration among business partners in which each party seeks to maximize its profits or values individually or jointly. However, various global environmental crises, such as global climate change, energy, clean water, biodiversity, air pollution, solid and waste management, and deforestation have increased global awareness, commitment, and agreement of the importance of internalizing the environmental effects into business practices. The purpose of this paper is to explore the potential of a triple-helix or ABG (academics-businesses-government) collaboration in enhancing green supply chain practices adoption and implementation in Indonesia. Therefore, the major methodology used in this paper is literature review.
We argue that a triple-helix collaboration, involving academics from higher education or universities, profit-seeking business, and government as policy makers can contribute in clarifying issues and defining roles and responsibilities among stakeholders involved in enhancing green supply chain practices in Indonesia. Because of the complexity of this issue, we propose various perspectives should be adopted, involving physical/geographical, technical/technological, social, economic, financial, environmental, and legal issues. This ABG (academics-businesses-government) collaboration is called upon to answer a criticism found in the literature review that most research in the green supply chain management highlights mismatch between high academic standards against relevance and operational implementation. In other words, future research directed towards exploring the potential of this ABG collaboration in the context of developing countries, especially Indonesia, will be worth pursuing and challenging. We argue that a single paradigm orientation to address this issue is in-sufficient; therefore, the critical theory paradigm with a mixed-methods research will be required in this investigation.

Keywords: green supply chain, triple helix, ABG (Academics-Businesses-Government), collaboration, Indonesia

1. Introduction

Supply chain management can be defined as any activities involved in planning, organizing, directing, and controlling of flows of materials, information, and capital or money (Handfield dan Nichols, 2002; Ballou, 2004; Simchi-Levi, Kaminsky, and Simchi-Levi, 2008; Chopra dan Meindl, 2010). Green supply chain management is any supply chain management that considers ecological or ecosystem perspective (Pears, 2000; Esty dan Winston, 2009), or environment (Rao, 2002; Hervani, Helms and Sarkis, 2005; Rao and Holt, 2005; Kaimuna and Tawara, 2006; McKinnon, 2010), or sustainable development (Diesendorf, 2000; Dunphy and Benveniste, 2000) leading to *sustainable supply chain* (Kleindorfer, Singhal and Van Wassenhove, 2005).
Practices of supply chain management involve collaboration among business partners in which each party seeks to maximize its profits or values individually or jointly. However, various global environmental crises, such as global climate change, energy, clean water, biodiversity, air pollution, solid and waste management, and deforestation have increased global awareness, commitment, and agreement of the importance of internalizing the environmental effects into business practices (Esty and Winston, 2009). An alternative approach to addressing collaboration among parties is the triple helix model, involving university (academia), businesses or the private sector, and the government.
Green supply chain practices have been commonly implemented in the developed countries. For developing countries, such as Indonesia, however, this will be a new initiative as well as challenge for any stakeholders involved in this issue. In this paper, we conjecture that a triple helix or ABG (academics-businesses-government) collaboration will be required (Svendsen and Laberge, 2005) to initiate and participate in the adoption and implementation of green supply chain practices among stakeholders to address the issue from various perspectives. Enhancing green supply chain practices in Indonesia will have a vital role in sustaining industry competitiveness, particularly due to the increasing commitment on global environmental issues (Steiner and Steiner, 2006).

2. Literature Review

This literature review is organized into three major topics, namely green supply chain management, triple helix model, and research methodology in supply chain and logistics research.

2.1 Green Supply Chain Management

Green supply chain practices have been mainly discussed in the context of private businesses seeking profit while keeping up with increased environmental performance. In this sense, green supply chain management may be put in the functional strategy level (as shown in Figure 1. From the top-down side, corporate strategy determines business areas to be chosen. This strategic level directs business strategy level, both competitive and cooperative. This tactical strategy level influences functional strategies, including operations strategy, such as green supply chain strategy. From the bottom-up side, green supply chain strategy supports the firm's business strategy, and this business strategy will in turn, supports corporate strategy (Waters, 2006; Beckman and Rosenfield, 2008; Finch, 2008; Slack and Lewis, 2008). Competitive advantages in the business strategy level can be divided into cost leadership or differentiation (Barney and Hesterly, 2006) and these competitive advantages can be realized into value attributes, such as quality, convenience, on time delivery, personalization, ethical consideration, style or fashion, and technology (Finch, 2008). Another competitive advantage resulting from green supply chain strategy is contribution to the environment or as known as eco-advantage (Esty and Winston, 2009).

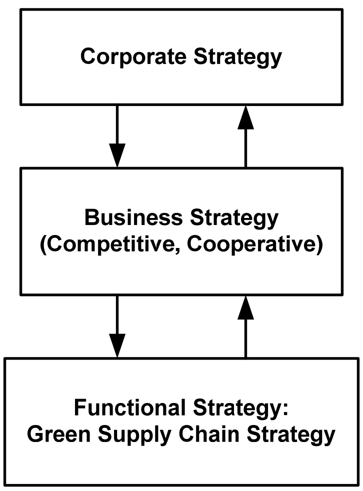


Figure 1. Hierarchy of green supply chain strategy

Research in green supply chain can mainly be divided into two major streams, namely content and process (Fahey and Christensen, 1986; Hutzschenreuter and Kleindienst, 2006). Research in the content mainstream deals with "what" question, referring to structural and infrastructural decisions involving standards, policies, and systems (Hayes et al., 2005; Beckman and Rosenfield, 2008; Slack and Lewis, 2008). The former deals with capacity, facility, location, technology, and supply networks, while the latter includes budget, human resources, production planning and inventory control, quality, product and service development, organization, and performance measurement (Hayes et al., 2005; Beckman and Rosenfield, 2008; Slack and Lewis, 2008). Research in the process mainstream deals with the "how" question and it is about dynamics, steps or stages, or mechanisms used in strategic alignment between external requirements and internal resources, processes, and capabilities (Slack and Lewis, 2008).

According to Emmet and Sood (2010), several drivers for the greening initiatives of supply chain management to support the achievement of sustainable development goals include government laws or regulation relating to environmental preservation, increasing public concerns that can affect the sustainability of any company's operations, mass media in distributing information and forming public understanding and reaction, more demanding customers who ask more responsibilities from producers, and a need for any firm to stay competitive and sustainable. Those drivers may generate various expected benefits. From an environmental point of view, green initiatives along a supply chain will result in green house emission reduction as well as reduction in waste, pollution, and environmental degradation. From an economic point of view, these initiatives will result in long-term profit, reduction of purchasing costs, reduction in waste management treatment and disposal, and increase in selling of more environmentally-friendly products. From a social point of view, those green initiatives will contribute to positive brand image building and creating a better and safe working environment. From a technological point of view, green initiatives will have a role in technology selection to reduce environmental degradation, creation of systematic innovation to increase greenness in the supply chain, and more efficient use of natural resources. From a legal or regulatory point of view, those green initiatives will support any firm's advantage in responding to any environmental laws, facilitate green commitment and agreements, and reducing any firm's risk due to violation of environmental laws. Table 1 summarizes these findings.

Table 1. Drivers for green supply chain practices

Aspect	Opportunities
Environment	• Reduction of emissi on • Reduction of waste, pollution, and environmental degradation
Economics	• Long-term profit • Reduction of procurement or purchasing cost • Reduction of waste management costs • Optimization of environmental management initiatives • Increased sales in more environmentally products
Social	• Positive brand image building for the company • Creation of safe working environment
Technology	• Technology choice for reducing environmental degradation • Creation of systematic process for identifying innovations along the supply chain to increase environmental friendliness • More efficient use of resources
Laws	• Leveraging a firm's competitive position in response to laws or regulations • Internalizing pressures and environmental agreement • Reducing a firm's risk due to environmental regulation

Source: Emmet and Sod (2000)

Opportunities for adopting and implementing green initiatives along a supply chain can be organized based on major processes by adapting the SCOR (Supply Chain Operations Reference), including: plan, source, make, store, deliver, sell, and return. A summary of green aspects, implementation opportunities and the associated references is provided in Table 2.

Table 2. Opportunities for adoption and implementation of green supply chain practices

Stage	Green aspect	Implementation opportunity (reference)
Plan	• Forecast green product needs supply and demand • Green product design and development • Design logistics networks	• Redesigning supply chain system (Esty and Winston, 2009; Harris et al., 2010) • Life cycle management (Emmett and Sood, 2010) • Selection of environmental performance indicators (Hervani, Helms and Sarkis, 2005)
Source	• Green procurement/purchasing	• Green materials (Wang and Gupta, 2011) • Green procurement (Wang and Gupta, 2011) • Environmental manajemen through cooperation with suppliers (Walton, Handfield, and Melnyk, 1998; Emmett and Sood, 2010)
Make	• Green product and process design • Green productions/operations • Green packaging	• Green products (Polonsky, Rosenberger, and Ottman, 1998) • Green customers (Wang and Gupta, 2011) • Environmental design (Wang and Gupta, 2011) • Green production (Wang and Gupta, 2011)

		• Implementation of ISO 14001 (Rao, 2002) • Audit of product carbon content (Esty and Winston, 2009; Piecyk, 2010) • Emission reduction (Emmett and Sood, 2010) • The use of internet (Esty and Winston, 2009; Edwards et al., 2010) • Redesigning packaging (Rao and Holt, 2005)
Store	• Green warehousing	• Energy consumption management (Marchant, 2010) • The use of green buildings (Marchant, 2010)
Deliver	• Green transport	• Mode selection (Rao and Holt, 2005; Cullinane and Edwards, 2010; Woodburn and Whiteing, 2010) • Conversion or selection of fuel (Cullinane and Edwards, 2010) • Improvement of vehicle utilization (McKinnon and Edwards, 2010) • Route optimization (Eglese and Black, 2010) • Improvement of fuel efficiency (McKinnonn, 2010) • Carbon management (Okereke and Russel, 2010)
Sell	• Green retailing • Green marketing	• Brand promotion (Esty and Winston, 2009; Emmett and Sood, 2010) • Eco-labeling (Rao and Holt, 2005)
Return	• Return management • Reuse • Recondition • Recycle • Environmentally-friendly disposal	• Waste management (Rao and Holt, 2005; Cherrett et al., 2010) and pollution (Esty and Winston, 2009; Emmett and Sood, 2010) • End-of-life management (Wang and Gupta, 2011)

A summary from Rao (2002), Rao dan Holt (2005), and Zhu, Sarkis dan Geng (2005) lists the following environmental performance indicators:

- Employee and management participation
- Published company's mission and values
- Sales of green products
- Design of environmental performance management system
- Environmental sertification
- Suppplier selection based on environmental consideration
- The use of more environmentally friendly technology
- Amount of penalty due to violations of environmental laws
- Amount of budget for environmental compliance
- Rewards received
- Amount of energy consumption
- Amount of electricity consumption
- Amount of fuel consumption
- Amount of water consumption
- Waste disposal costs
- Number of complaints from a community
- Improvement initiatives
- Emission reduction
- Wastewater reduction
- Solid waste reduction
- Noise pollution reduction
- Reduction of hazardous materials consumption

- Reduction of environmental accidents
- Improvement of a firm's environmental condition
- Increased investment
- Increased operations costs
- Increased training costs
- Increased budget for procurement of more environmentally friendly materials
- Reduction of procurement costs
- Reduction of energy consumption
- The use of alternative fuel
- Reduction of waste management costs
- Increased number of on-time product delivery
- Inventory reduction
- Scrap reduction
- Increased promotion for product quality
- Increased product lines
- Increased capacity utilization
- Source separation activities
- Recycling activities
- Product modification
- Raw material modification
- Process modification
- Packaging redesign

2.2 Triple Helix Models and Stakeholders

There is a bunch of publications on triple helix models, especially in the context of innovation and economic development (Bunders, Broerese, and Zweekhorst, 1999; and Klafsten, Jones-Evans, and Schaberg, 1999; Leydesdorff and Meyer, 2003; Johnson, 2007; Brundin et al., 2008; Lu, 2008; and Zhou, 2008). However, investigation of the triple helix model in the context of green supply chain management has rarely been addressed by previous research. In the area of waste management research, Fernandez (1993) proposed stakeholders' involvement in solid waste policy and action. In this regard, Fernandez categorized stakeholders' roles into three, namely policy, supportive roles, and action. This simple classification can be used as a basis for identifying roles of academia, businesses, and government in the context of green supply chain management. Table 3 summarizes Fernandez's stakeholders' roles in municipal solid waste management in developing countries.

Table 3. Stakeholders' roles in municipal waste management in developing Countries

Stakeholder	Generation	Storage	Separation, recycling and processing	Collection	Transportation	Intermediate treatment	Disposal
Central government	Policy		Policy		Supportive role	Supportive role	Policy
Municipal government		Policy	Policy	Policy & Action	Policy &Action	Policy & Action	Policy & Action
Private solid waste businesses	Supportive role	Supportive role	Supportive role	Policy	Policy	Policy	Policy
Private industry	Supportive role	Supportive role	Supportive role				
Community organization	Policy & Supportive role	Action	Action	Action	Supportive role	Supportive role	Supportive role
NGOs (national scope)	Supportive role	Supportive role	Policy	Policy		Supportive role	Supportive role
Waste pickers at dump site						Supportive role	Policy
Itinerant waste pickers		Action	Supportive role				
Households	Action	Action	Action	Supportive role			
Collectors (individual)	Action	Action	Action	Action	Supportive role	Supportive role	Supportive role
Schools	Policy	Policy	Policy				

Source: Fernandez (1993)

2.3 Research Methodology

Neuman (2009) classified three major approaches to social science, namely positivist social science, interpretive social science, and critical social science. Sachan and Datta (2005) conducted a comprehensive literature review on supply chain and logistics research. They categorized their findings into these three approaches and added one more, namely axiomatic. These four approaches were used to classify the nature of truth as shown in Figure 2. Another axis in their classification was the kind of information used, in a continuum of natural to artificial. Although their review was not particularly addressed for green supply chain, but it can also be used to classify research on green supply chain management.

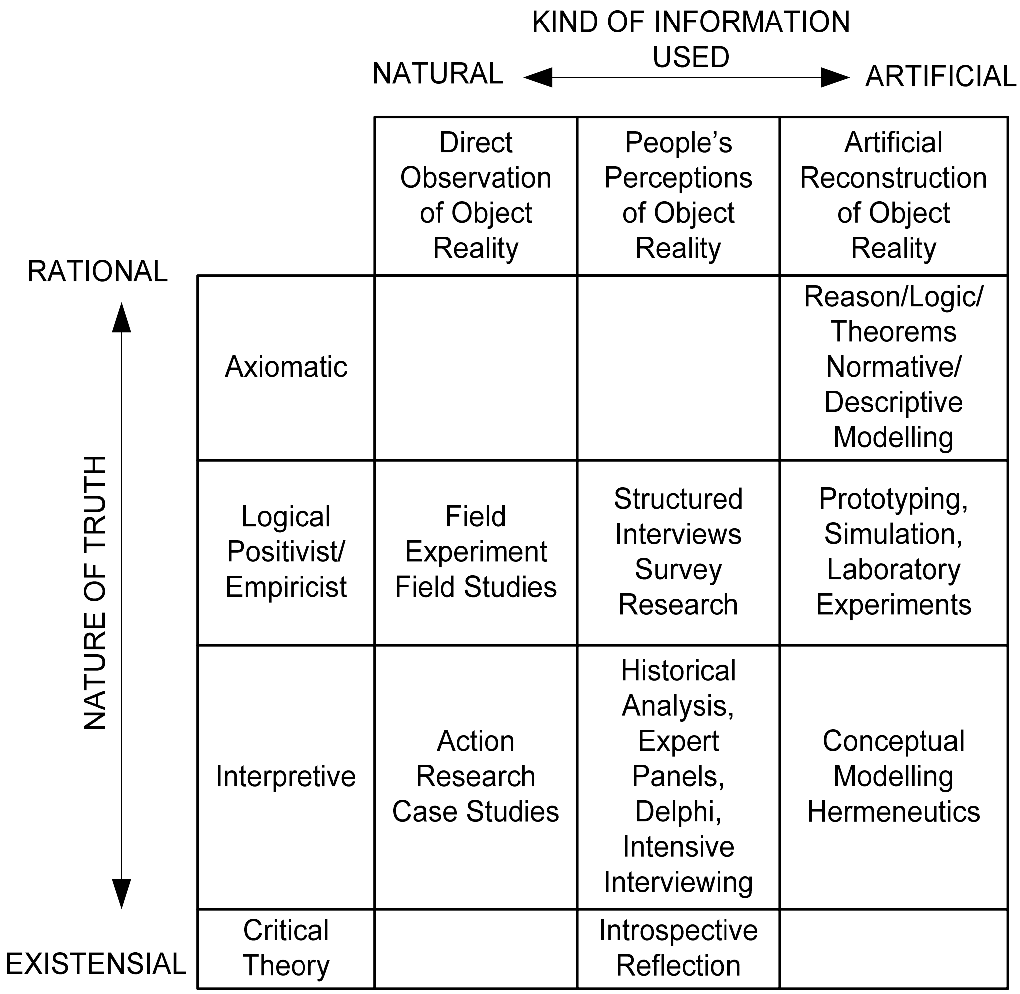


Figure 2. Classification of research methodology in supply chain and logistics research
Source: Sachan and Datta (2005).

3. Methodology

The major research methodology for this paper is mainly based on literature review, recognizing that this issue is a relatively new issue in Indonesia, although environmentally friendly business practices may have been done in certain companies. Literature review provides concepts that can be used to propose a conceptual framework for enhancing green supply chain practices in Indonesia through a collaboration involving academia, businesses, and government (ABG).

4. ABG Collaboration in Green Supply Chain Practices in Indonesia

4.1 The Proposed Conceptual Framework

A conceptual framework for enhancing green supply chain practices using an ABG model consists of thee major components, namely activities, aspects, and actors as shown in Figure 3. This approach was used by Yudoko (2004) in developing a conceptual framework of integrated municipal solid waste planning and management in developing countries. From the literature review, activities in green supply chain may include more environmentally friendly practices in forecasting demand and supply, strategy and design of supply networks, procurement or purchasing, product design and development, design and selection of process technologies, production or operations, design and use of packaging, warehousing, transportation, sales and marketing, service, and reverse logistics. Various aspects relevant in the context of green supply chain practices in Indonesia include physical/geographical, technical/technological, social, economic, financial, environmental, and legal issues. The three main actors of the conceptual model are academia, businesses, and government.

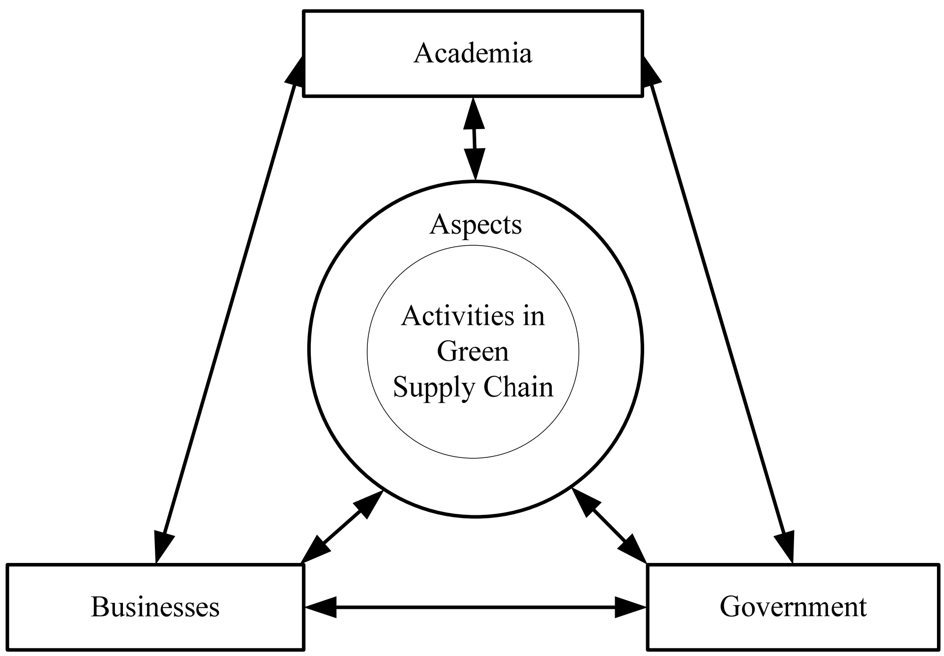


Figure 3. ABG collaboration in green supply chain practices

Dyadic communication and/or collaboration may occur between academia and businesses, academia and government, and businesses and government. Three lateral communication or collaboration involves the three main actors as shown in the center of the framework.

4.2. Roles of ABG

Adopting classification of stakeholders' roles from Fernandez (1993), each actor may assume role as actor, facilitator, and/or policy makers in any environmentally friendly green supply chain practices. Involvement level can be categorized into high, medium, and low level. Table 4 proposes each role and possible associated involvement. As we can see from the table, academia plays its major role as facilitator in all environmentally friendly (green) supply chain practices. Academia's involvement can be high especially in areas involving research, such as in product design and development, design and selection of process technologies, and design and use of packaging. Academia's role may be low as in the area of production or operations and warehousing. And academia may have medium level role in the form of consulting, such as in forecasting demand and supply of green products, strategy and design of supply networks, procurement and purchasing, transportation, sales and marketing, service design, and reverse logistics.

Businesses have the biggest role as actor or doer in all environmentally friendly (green) supply chain practices. Businesses conduct these practices to achieve their goals and respectively maintain their competitiveness in the current globalized context. In this regard, businesses have high level involvement in all green supply chain practices. Government can have its major role as policy maker as well as facilitators. Policy making may involve national and regional strategy and design of supply network; government code of conduct in procurement or purchasing, especially for government institutions; national standards for green operations; national and regional transportation design; sales and marketing of green products; and design and strategy of reverse logistics networks. Government may play as facilitators to support forecasting of demand and supply of green products, green product design and development, design and selection of green process technologies, redesign of green packaging, green warehousing, and safe service. Government should be aware of the policy context of green supply chain practices that are related to green economy and sustainable development as shown in Figure 4.

Table 4. ABG's roles in green supply chain practices

More environmentally friendly (green) supply chain practices	Academia		Businesses		Government	
	Roles	Level	Roles	Level	Roles	Level
Forecasting demand and supply	F	M	A	H	F	M
Strategy and design of supply networks	F	M	A	H	P	H
Procurement or purchasing	F	M	A	H	P	H
Product design and development	F	H	A	H	F	L
Design and selection of process technologies	F	H	A	H	F	M
Production or operations	F	L	A	H	P	H
Design and use of packaging	F	H	A	H	F	L
Warehousing	F	L	A	H	F	M
Transportation	F	M	A	H	P	H
Sales and marketing	F	M	A	H	P	L
Service	F	M	A	H	F	L
Reverse logistics	F	M	A	H	P	H

Legend: P = policy, F = Facilitator, A = Actor
H = high involvement, M = medium involvement, L = low involvement

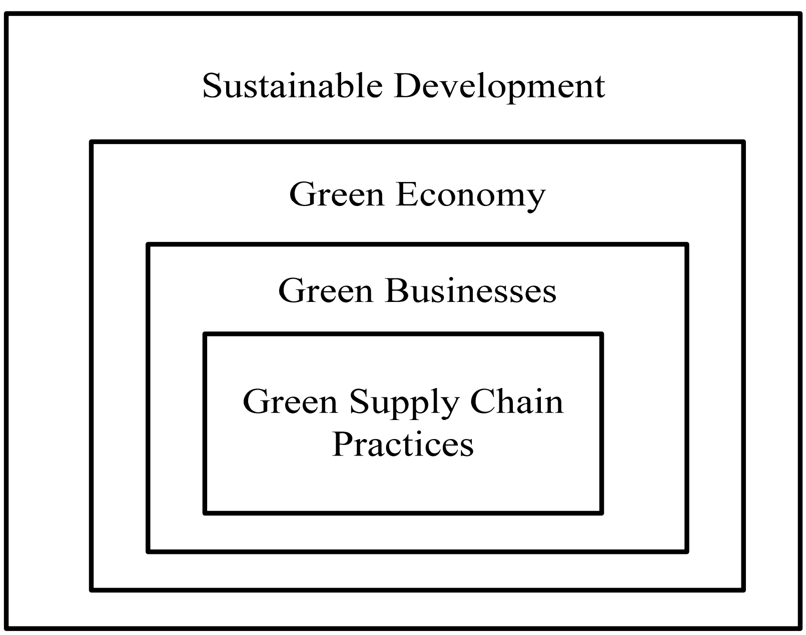


Figure 4. The policy context of green supply chain practices

4.3 Collaboration Options

Based on Hooper, McDonald and Mitchell (1999), options for collaboration involving academia, businesses, and government in any possible environmentally friendly (green) supply chain practices can be divided into voluntary, collaborative, and coercive. Each option has its own unique characteristics from four considerations, namely emphasis regarding collaboration, assumption about collaboration, structures of collaboration, and implementation consideration.

Voluntary option is based on recognition that each actor may have its own interests, goals, capacity, and current practices that are not ready for sustained intensive collaboration with the others. Therefore, no targeted performance goals or outcomes can be expected from this kind of option. It is assumed that each actor has its freedom right to not participate at this time due to any kind of reason. Because of this voluntary nature, collaboration can be in one-way or limited two-way communication, for instance, government gives academia to conduct a research on fuel alternative development in Indonesia. Benefits from this voluntary collaboration are minimal.

Collaborative option is expected to emerge as we believe this will enhance more green supply chain practices in Indonesia than the voluntary option. In this collaborative option, the actors involved discuss and get an agreement on prescribe common goals and processes, and specify communication or collaboration mechanisms, considerations, along with performance goals. Collaborative option assumes that each actor will have good will, trust, respect and willingness to work collaboratively. In other words, compliance is not a problem as each actor is aware of their expected participation and contribution by others. It is recognized, however, that discretion should be encouraged regarding each actor's capacity to assume their roles and responsibilities. The structure of collaboration can be achieved through a mutually acceptable coordinating mechanism, developed by the three actors and each actor can have lead roles depending upon the issue or problem to be addressed. Implementation consideration includes building capacity for each actor to engage in collaboration and encouraging consideration of benefits to be realized through integration, collaboration and coordination.

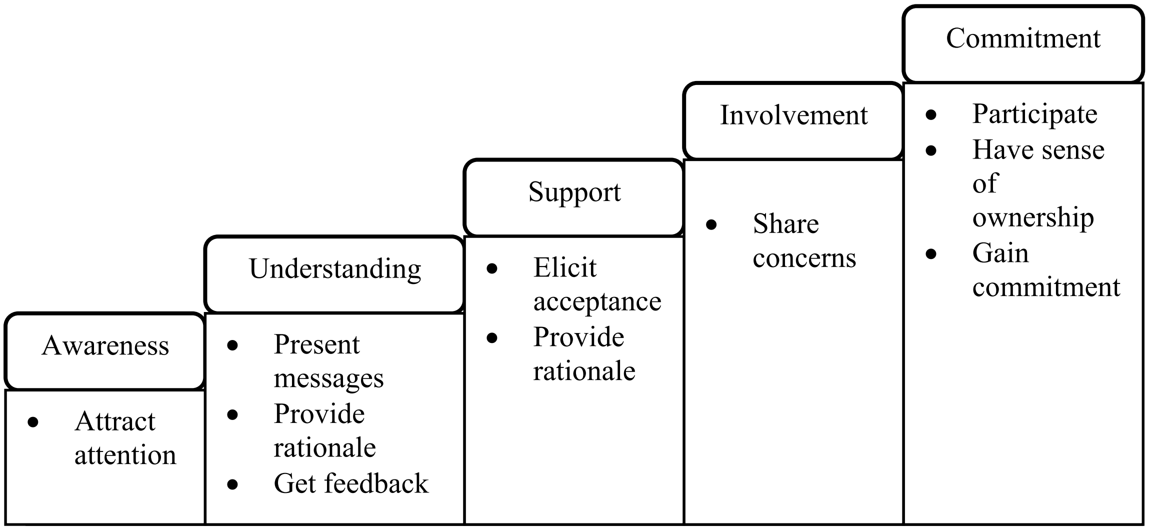
In the coercive option, there are situations requiring collaboration compliance, for instance global consensus on climate change has mandated Indonesia to take part. As a consequence, this issue becomes mandatory and it must be addressed by specifying regulatory actions and conditions, along with required processes and plans. Assumption of this option is that compliance is a potential problem and willingness to work together is not apparent, and therefore prescription is necessary. The structure of collaboration in this coercive option is through policy and/or institution innovation. Implementation consideration involves inducing adherence to policy prescriptions and regulatory standards and building calculated commitment as a primary means to achieve compliance. It should be noted here that academia and businesses should be invited and involved by the government in this option. Table 5 summarizes the three collaborative options in enhancing green supply chain practices in Indonesia.

Changes are common phenomena in environmental management. Hadfield and Seaton (1999) classified different kinds of changes, such as physical, knowledge, technological, perceptual, policy, institutional and behavioral. Quirke (1997) contended that communication has a pivotal role in managing change, in particular organizational (institutional) and behavioural changes. A conceptual framework for communicating change, called "the communication escalator" as shown in Figure 5, is proposed by Quirke. The model is based on a premise that communicating change is a continuous and dynamic process. This communication model can be applied to bridge from voluntary to collaborative option.

The communication escalator consists of five main stages: creating and increasing awareness, building understanding, gaining support, involving people (stakeholders), and gaining commitment. The aim is to make all actors move up to the highest ladder or to gain their commitment. The higher the ladder, the more face-to-face interactions are being used. The main aim of creating and increasing awareness is to attract attention from stakeholders. This is consistent with Hadfield and Seaton's (1999) argument that a change will become meaningful when it draws attention or consideration of the people. This first stage can be conducted through distribution of information. The second stage, building understanding, is aimed at providing the rationale for change, getting feedback and refining the communication process between the sender and the recipient. Besides reminding again about the rationale for change, another objective of the third stage (gaining support) is to elicit acceptance of stakeholders concerning the significance and necessity of the change. The fourth stage, involving people, is performed by sharing concerns. The last stage is to gain commitment of stakeholders and this can occur if they have participated because participation can nurture a sense of ownership

Table 5. Collaboration options in enhancing green supply chain practices in Indonesia alternatives

Features	Voluntary	Collaborative	Coercive
• Emphasis regarding collaboration	• Encourage consideration of each actor's interests, goals, capacity, and practices. • Do not specify targeted performance goals or outcomes.	• Discuss and get an agreement on prescribe common goals and processes. • Specify communication or collaboration mechanisms, considerations, along with performance goals.	• Prescribe regulatory actions and processes. • Specify regulatory actions and conditions, along with required processes and plans.
• Assumption about collaboration	• Each actor has its own freedom to participate due to various reasons.	• Good will, trust, respect and willingness to work collaboratively • Compliance is not a problem. • Discretion should be encouraged regarding each actor's capacity to assume roles and responsibilities.	• Compliance is a potential problem. • Willingness to work together is not apparent, and prescription is necessary.
• Structures of collaboration	• Can be one-way or two-way communication	• A mutually acceptable coordinating mechanism is developed by participants. • Each actor can have lead roles depending upon the issue or problem to be addressed.	• A new policy and/or institution may be created, which is given some or all of the powers and responsibilities to accomplish certain mission
• Implementation consideration	• Minimum benefits	• Build capacity for each actor to engage in collaboration • Encourage consideration of benefits to be realized through integration, collaboration and coordination.	• Induce adherence to policy prescriptions and regulatory standards. • Build calculated commitment as a primary means to achieve compliance.



4.4 Research Methodology

As mentioned previously, there are three major research paradigms that can be adopted in studying green supply chain practices in Indonesia, namely positivist social science, interpretive social science and critical social science. Based on Sachan and Datta (2005), axiomatic can be added to these three. Characteristics of research object can be organized into real system and artificial system. This classification is shown in Figure 6.
The nature of truth of any phenomenon related to green supply chain practices in Indonesia can be approached by the four major paradigms, ranging from realistic, existensial phenomemnon to abstract, rational one. The axiomatic paradigm approaches a research phenomenon using mathematical or logical modeling to describe or explain a real existing system. We argue that axiomatic paradigm may also be used in the normative system, espousing the ideal, required artificial system because the existing real system is not the ideal one. The positivist, deductive, quantitative paradigm is a top-down approach, starting from literature review, model building, and model testing. This paradigm can be applied in a real system for descriptive, explanatory, and normative and in artificial system for the normative system. A lot of methods are available for this paradigm, including survey, interviews, real experiments, simulation, action research, prototyping, and laboratory experiments. The interpretive, inductive, qualitative paradigm can be used in any research involving real system and artificial system. This paradigm is very well suited for context, specific research that may not be generalizable in other contexts. The critical theory, pragmatist, mixed paradigm concerns only with a normative system, especially the real system since its major endeavor is to change the existing system into a better one. This paradigm is characterized by action research and the use of mixed methods.

Characteristics of Research Object

Real System | Artificial System

Rational (Abstract)

Nature of Truth

Existensial

	Exploratory	Descriptive	Explanatory	Normative	Normative
Axiomatic		Mathematical or Logical Modelling	Mathematical or Logical Modelling		Mathematical or Causal Logic/ Theorems Normative Modelling
Positivist-Deductive-Quantitative		Survey Interviews	Survey Experiments Simulation	Survey Experiments Simulation Action Research	Prototyping, Simulation, Laboratory Experiments
Interpretive – Inductive - Qualitative	Phenomeno-logy Ethnography Case Studies Grounded Theory	Historical Analysis, Expert Panels, Delphi, Intensive Interviewing	Phenomeno-logy Ethnography Case Studies Grounded Theory	Historical Analysis, Expert Panels, Delphi, Intensive Interviewing, Action Research	Conceptual Modelling Hermeneutics
Critical Theory – Pragmatist - Mixed				Action Research, Mixed Methods (Quantitative, Qualitative)	

Figure 6. Research paradigms for research in green supply chain practices in Indonesia

5. Conclusions

Several conclusions can be drawn from this paper. First, there are various green supply chain practices that can be explored and applied in the Indonesian context, namely forecasting demand and supply, strategy and design of supply networks, procurement or purchasing, product design and development, design and selection of process technologies, production or operations, design and use of packaging, warehousing, transportation, sales and marketing, service, and reverse logistics. Second, enhancing green supply chain practices calls for collaboration, involving academia, businesses, and government. Each actor may assume its appropriate roles and responsibilities, either as actor, facilitator, and/or policy maker. Third, collaboration of academia, businesses, and government may tackle various kinds of change, including physical, knowledge, technology, perception, policy, institutions and behavior. These changes imply complexities of issues and problems related to enhancing green supply chain practices in Indonesia. Fourth, the nature and level of collaboration involving academia, businesses, and government in any of these green practices may be in voluntary, collaborative, and coercive option. Each option has its unique characteristics, at least from four perspectives, namely emphasis regarding collaboration, assumption about collaboration, structures of collaboration, and implementation consideration. Fifth, to support and move up from the voluntary to the collaborative option, an evolutionary, communication ladder is recommended, recognizing that each actor may have different understandings and capacities to respond to the call for more environmentally friendly (green) supply chain practices requiring collaboration from the other actors. This communication ladder consists of awareness, understanding, support, involvement, and commitment. Last, research methodology for enhancing green supply chain practices in Indonesia may include axiomatic, positivist, interpretivist, and critical theorist to address either the real existing system or artificial system.

6. Policy Implications

In this paper, policy implications refer to the government role's as the policy maker related to any issues in enhancing green supply chain practices in Indonesia. The central, provincial and local governments may propose their policy to address any issue particular to a certain spatial and temporal context. As mentioned previously, the role of government as policy makers can be seen in particularly in national and regional strategy and design of green supply network; government code of conduct in green procurement or purchasing, especially for government institutions; national standards for green operations; national and regional green transportation design; sales and marketing of green products; and design and strategy of reverse logistics networks. The role of government is also vital to address any issue requiring compliance as in the case of coercive option. Various policy instruments (Pal, 1997) can be used to implement any government initiative relating to policy implementation in green supply chain practices in Indonesia, such as cash grant, certification, administered contract, information dissemination, investment, tax deduction, procedural guidelines, license/permit, in-kind, fee/charge, prohibition, public promotion, and education.

7. Directions for Further Research

Various scientific and practical endeavors can be conducted in enhancing green supply chain practices in Indonesia, involving collaboration of academia, businesses, and government. It is strongly argued that a critical theory is proposed since it concerns with mapping the existing green supply chain practices, identifying weaknesses, visioning the better green supply chain practices, setting up an agenda for change, and education. This adoption of this critical paradigm may use a mixed-methods (Creswell and Plano Clark, 2011) from those methods available in the positivist as well as the interpretive paradigms. The interpretive paradigm will be used to explore the existing practices and elicit issues, interests, challenges, and problems. The positivist paradigm can be used to find a few benchmarks of the better or best practices in any developed countries. Participatory action research can be used to facilitate interactions among stakeholders and build a consensus for the best, suitable green supply chain vision for Indonesia and then set up an agenda for change. Research on education of stakeholders will also be important as this will be a long process to accomplish. It is hoped that this research agenda can answer the critique that most research in the green supply chain management highlights mismatch between high academic standards against relevance and operational implementation (Gupta, Verma, and Victorino, 2006; Dess and Markoczy, 2008; Dooley, 2009).

References

Allen, J. and Brown, M., 2010. Sustainability strategies for city logistics. In: McKinnon, A., Cullinane, S., Browne, M. and Whiteing, A. (eds.), *Green Logistics: Improving the environmental sustainability of logistics*, London: KoganPage.

Ballou, R.H., 2004. *Business Logistics/Supply Chain Management*, 5th ed. New Jersey: Pearson Prentice Hall.

Barney, B.B. and Hesterly, W.S., 2006. *Strategic Management and Competitive Advantage: Concepts*, New Jersey: Pearson Prentice Hall.

Beckman, S.L. and Rosenfield, D.B., 2008. *Operations Strategy: Competing in the 21st Century*, New York: McGraw-Hill.

Brundin, E., Wigren, C., Isaacs, E., Friedrich, C., and Visser, K., 2008. "Triple Helix Networks in a Multicultural Context: Triggers and Barriers for Fostering Growth and Sustainability", *Journal of Developmental Entrepreneurship*, Vol. 13, No. 1, 77-98.

Bunders, J.F.G., Broerse, J.E.W., and Zweekhorst, M.B.M., 1999. "The Triple Helix Enriched with the User Perspective: A View from Bangladesh", *Journal of Technology Transfer*, No. 24, 235-246.

Chopra, S. and Meindl, P. 2010. *Supply Chain Management: Strategy, Planning, and Operation*. 4th ed. New Jersey: Pearson.

Cherrett, T., Maynard, S., McLeod, F. and Hickford, A., 2010. "Reverse logistics for the management of waste". In: McKinnon, A., Cullinane, S., Browne, M. and Whiteing, A. (eds.), *Green Logistics: Improving the environmental sustainability of logistics*, London: KoganPage.

Creswell, J.W., 2003. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, 2nd ed. California: Sage.

Creswell, J.W. and Plano Clark, V.L., 2011. *Designing and Conducting Mixed Methods Research*, 2nd ed. California: Sage.

Cullinane, S. and Edwards, J., 2010. “Assessing the environmental impacts of freight transport”. In: McKinnon, A., Cullinane, S., Browne, M. and Whiteing, A. (eds.), *Green Logistics: Improving the environmental sustainability of logistics*, London: KoganPage.

Cullinane, S. and Edwards, J., 2010. “Benefits and costs of switching to alternative fuels”. In: McKinnon, A., Cullinane, S., Browne, M. and Whiteing, A. (eds.), *Green Logistics: Improving the environmental sustainability of logistics*, London: KoganPage

De Castro, E.A., Rodrigues, C., Esteves, C., and Pires, A.R. 2000. “The triple helix model as a motor for the creative use of telematics”, *Research Policy*, No. 29, 193-203.

Dess, G.G. and Markoczy, L., 2008. ”Rather than searching for the silver bullets, use rubber bullets: A view on the research-practice gap”. *Journal of Supply Chain Management*, 44(2), pp. 57-62.

Diesendorf, M., 2000. “Sustainability and sustainable development”. In: Dunphy, D., Benveniste, J., Griffiths, A., and Sutton, P., 2000. *Sustainability: The corporate challenge of the 21st century*, New South Wales (Australia): Allen & Unwin.

Dooley, K.J., 2009. “The Empiricism-Modeling Dichotomy in Operations and Supply Chain Management. *Journal of Supply Chain Management*, 45(1), pp. 38-43.

Dunphy, D., 2000. “Implementing the sustainable corporation”. In: Dunphy, D., Benveniste, J., Griffiths, A., and Sutton, P., 2000. *Sustainability: The corporate challenge of the 21st century*, New South Wales (Australia): Allen & Unwin.

Dunphy, D. and Benveniste, J., 2000. “An introduction to the sustainable corporation”. In: Dunphy, D., Benveniste, J., Griffiths, A., and Sutton, P., 2000. *Sustainability: The corporate challenge of the 21st century*, New South Wales (Australia): Allen & Unwin.

Edwards, J., Wang, Y., Potter, A. and Cullinane, S., 2010. “E-business, e-logistics and the environment”. Cullinane, S. and Edwards, J., 2010. Assessing the environmental impacts of freight transport. In: McKinnon, A., Cullinane, S., Browne, M. and Whiteing, A. (eds.), *Green Logistics: Improving the environmental sustainability of logistics*, London: KoganPage

Emmet, S. and Sood, V., 2010. *Green Supply Chains*, Chichester: Wiley.

Esty, D.C. and Winston, A.S., 2009. *Green to Gold*, New Jersey: Wiley.

Eglese, R. and Black, D., 2010. “Optimizing the routing of vehicles”. In: McKinnon, A., Cullinane, S., Browne, M. and Whiteing, A. (eds.), *Green Logistics: Improving the environmental sustainability of logistics*, London: KoganPage.

Fahey, L. and Christensen, H.K., 1986. “Evaluating the Research on Strategy Content”. *Journal of Management*, 12, pp. 167-184.

Fernandez, A.L., 1993. “Public-private partnerships in solid waste management”, *Regional Development Dialogue*, Vol. 4, No. 3, 3-23.

Finch, B.J., 2008. *Operations Now: Supply Chain Profitability and Performance*, 3rd ed. New York: McGraw-Hill.

Giunipero, L.C., Hooker, R. E., Joseph-Matthews, S., Yoon, T.E. and Brudvig, S., 2008. “A Decade of SCM Literature: Past, Present and Future Implications”. *Journal of Supply Chain Management*, 44(4), pp. 66-86.

Gupta, S., Verma, R. and Victorino, L., 2006. “Empirical Research Published in *Production and Operations Management* (1992-2005): Trends and Future Research Directions”. *Production and Operations Management*, 15(3), pp. 432-448.

Hadfield, L. and Seaton, R.A.F., 1999. “A co-evolutionary model of change in environmental management”, *Futures*, Vol. 31, No. 6, 577-592.

Handfield, R.B. and Nichols, Jr., E.L., 2002. *Supply Chain Redesign: Transforming Supply Chins into Integrated Value Systems*, New Jersey: FT Prentice Hall.

Harris, I., Rodrigues, V.S., Naim, M. And Mumford, C., 2010. “Restructuring of logistics systems and supply chains”. In: McKinnon, A., Cullinane, S., Browne, M. and Whiteing, A. (eds.), *Green Logistics: Improving the environmental sustainability of logistics*, London: KoganPage.

Hayes, R., Pisano, G., Upton, D., and Wheelwright, S., 2005. *Operations, Strategy, and Technology: Pursuing the Competitive Edge*. New Jersey: Wiley.

Hervani, A.A., Helms, M.M., and Sarkis, J., 2005. “Performance measurement for green supply chain management”. *Benchmarking*, 12 (4), pp. 330-353.

Hooper, B.P., McDonald,G.T., and Mitchell, B., 1999. “Facilitating Integrated Resources and Environmebtal Management: Australian and Canadian Perspectives”, *Journal of Environmental Planning and Management*, Vol. 42, No. 5, 747-766.

Hutzschenreuter, T. and Kleindienst, I., 2006. "Strategy-Process Research: What Have We Learned and What Is Still to be Explored". *Journal of Management*, 32(5), pp. 673-720.

Johnson, W.H.A., 2007. "Managing Collaborations of Engineering Management with Academia and Government in Triple Helix Technology Development Projects: A Case Example of Precarn from the Intelligent System Sector", *Engineering Management Journal*, Vol. 19, No. 2, 12-22.

Kaimuna, Y. and Tawara, N., 2006. "A multiple attribute theory approach to lean and green supply chain management". *International Journal of Production Economics*, 101, pp. 99-108.

Kleindorfer, P.R., Singhal, K. and Van Wassenhove, L.N., 2005. "Sustainable Operations Management". *Production and Operations Management*, 14(4), pp. 482-492.

Klofsten, M., Jones-Evans, D., and Scharberg, C., 1999. "Growing the Linkoping Technopole – A Longitudinal Study of Triple Helix Development in Sweden", *Journal of Technology Transfer*, No. 24, 125-138.

Leydesdorff, L. and Meyer, M. 2003. "The Triple Helix of university-industry-government relations", *Scientometrics*, Vol. 58, No. 2, 191-203.

Lu, L., 2008. "Creating knowledge-based innovation in China: The strategic implications of triple helix model", *Journal of Technology Management in China*, Vol. 3, No. 3, 249-263.

Marchant, C., 2010. "Reducing the environmental impact of warehousing". In: McKinnon, A., Cullinane, S., Browne, M. and Whiteing, A. (eds.), *Green Logistics: Improving the environmental sustainability of logistics*, London: KoganPage.

McKinnon, A., 2010. "Environmental Sustainability: a new priority for logistics managers". In: McKinnon, A., Cullinane, S., Browne, M. and Whiteing, A. (eds.), *Green Logistics: Improving the environmental sustainability of logistics*, London: KoganPage.

McKinnon, A., 2010. "Increasing fuel efficiency in the road freight sector". In: McKinnon, A., Cullinane, S., Browne, M. and Whiteing, A. (eds.), *Green Logistics: Improving the environmental sustainability of logistics*, London: KoganPage.

McKinnon, A., 2010. "The role of government in promoting green logistics". Cullinane, S. and Edwards, J., 2010. Assessing the environmental impacts of freight transport. In: McKinnon, A., Cullinane, S., Browne, M. and Whiteing, A. (eds.), *Green Logistics: Improving the environmental sustainability of logistics*, London: KoganPage.

McKinnon, A. nd Edwards, J., 2010. "Opportunities for improving vehicle utilization". In: McKinnon, A., Cullinane, S., Browne, M. and Whiteing, A. (eds.), *Green Logistics: Improving the environmental sustainability of logistics*, London: KoganPage.

McKinnon, A., Allen, J. and Woodburn, A., 2010. "Development of greener vehicles, aircraft and ships". In: McKinnon, A., Cullinane, S., Browne, M. and Whiteing, A. (eds.), *Green Logistics: Improving the environmental sustainability of logistics*, London: KoganPage.

Neuman, W.L., 2009. *Social Research Methods: Qualitative and Quantitative Approaches*, 7th ed.. Boston: Pearson Allyn and Bacon.

Okereke, C. and Russel, D., 2010. "Regulatory Pressure and Competitive Dynamics: Carbon Management Strategies of UK Energy-Intensive Companies". *California Management Review*, 52(4), pp. 100-124.

Olson, M.H. and Toyne, P., 2000. "Guiding principles: the way ahead". In: Dunphy, D., Benveniste, J., Griffiths, A., and Sutton, P., 2000. *Sustainability: The corporate challenge of the 21st century*, New South Wales (Australia): Allen & Unwin.

Pal, L.A., 1997. *Beyond Policy Analysis: Public Issue Management in Turbulent Times*. Ontario, Canada: International Thomson Publishing.

Pears, A., 2000. "Technologies and processes for ecological sustainability". In: Dunphy, D., Benveniste, J., Griffiths, A., and Sutton, P., 2000. *Sustainability: The corporate challenge of the 21st century*, New South Wales (Australia): Allen & Unwin.

Piecyk, M., 2010. "Carbon auditing of companies, supply chains and products". In: McKinnon, A., Cullinane, S., Browne, M. and Whiteing, A. (eds.), *Green Logistics: Improving the environmental sustainability of logistics*, London: KoganPage.

Piecyk, M., McKinnon, A., and Allen, J., 2010. "Evaluating and internalizing the environmental costs of logistics". In: McKinnon, A., Cullinane, S., Browne, M. and Whiteing, A. (eds.), *Green Logistics: Improving the environmental sustainability of logistics*, London: KoganPage.

Polonsky, M.J, Rosenberger, P.J., and Ottman, J., 1998. "Developing Green Products: Learning from Stakeholders", *Asia Pacific Journal of Marketing and Logistics*, Vol. 10, No. 1, 22-43.

Quirke, B., 1997. "Smoothing the Path of Change", *World Executive Digest,* March, 52-54.

Rao, P. and Holt, D., 2005. "Do green supply chains lead to competitiveness and economic performance?", *International Journal of Operations & Production Management*, 25(9/10), pp. 898-916.

Rao, P., 2002. "Greening the supply chain: a new initiative in South East Asia". *International Journal of Operations & Production Management*, 22(5/6), pp. 632-652.

Sachan, A. and Datta, S., 2005. "Review of supply chain management and logistics research". *International Journal of Physical Distribution & Logistics Management*, 35(9/10), pp. 664-705.

Simchi-Levi, D., Kaminsky, P. and Simchi-Levi, E., 2008. *Designing and Managing the Supply Chain*, 3rd ed. New York: McGraw-Hill.

Slack, N. and Lewis, M., 2008. *Operations Strategy*, 2nd ed. Essex: FT Prentice Hall.

Srivastava, S.K., 2008. "Network design for reverse logistics", *Omega*, No. 36, 535-548.

Steiner, G.A. and Steiner, J.F., 2006. Business*, Government, and Society: A Managerial Perspective, Text and Cases*, 11th Edition, Boston: McGraw-Hill Irwin.

Sutton, P., 2000. "Building corporate capabilities to promote ecological sustainability: a 'case study'". In: Dunphy, D., Benveniste, J., Griffiths, A., and Sutton, P., 2000. *Sustainability: The corporate challenge of the 21st century*, New South Wales (Australia): Allen & Unwin.

Stock, J.R. and Lambert, D.M., 2001. *Strategic Logistics Management*, 4th ed. New York: McGraw-Hill.

Svendsen, A.C. and Laberge, M., 2005. "Convening Stakeholder Networks: A New Way of Thinking, Being and Engaging", *The Journal of Corporate Citizenship*, No. 19, 91-104.

Swamidass, P.M., 1991. "Empirical Science: New Frontier in Operations Management Research". *Academy of Management Review*, 16(4), pp. 793-814.

Tibbs, H., 2000. "The technology strategy of the sustainable corporation". In: Dunphy, D., Benveniste, J., Griffiths, A., and Sutton, P., 2000. *Sustainability: The corporate challenge of the 21st century*, New South Wales (Australia): Allen & Unwin.

Trent, R.J., 2007. *Strategic Supply Management: Creating the Net Source of Competitive Advanta*ge. Florida: J. Ross Publishing.

Ughetto, E., 2007. "Foresight as a triple helix of industry, university, and government relations", *Foresight*, Vol. 9, No., 5, 14-22.

Walton, S.V., Handfield, R.B., and Melnyk, S.A., 1998. "The Green Supply Chain: Integrating Suppliers into Environmental Management Processes". *International Journal of Purchasing and Materials Management*, 34(2), pp. 2-11.

Wang, H., and Gupta, S.M., 2011. *Green Supply Chain Management: Product Life Cycle Approach*. New York: McGraw Hill.

Waters, S., 2006. *Operations Strategy*, London(U.K.): Thomson.

Woodburn, A. and Whiteing, A., 2010. "Transferring freight to "greener" transport modes". In: McKinnon, A., Cullinane, S., Browne, M. and Whiteing, A. (eds.), *Green Logistics: Improving the environmental sustainability of logistics*, London: KoganPage.

Yudoko, G., 2004. "Integrated Munici[al Solid Waste Planning and Management (IMSWPM) in Developing Countries: A Conceptual Framework", *Jurnal Manajemen Teknologi*, Vol. 5, December, 23-35.

Zhou, C., 2008. "Emergence of the entrepreneurial university in evolution of the triple helix: The case of Northeastern University of China", *Journal of Technology Management in China*, Vol. 3, No. 1, 109-126.

Zhu, Q., Sarkis, J., and Geng, Y., 2005. "Green supply chain management in China: pressures, practices and performance". *International Journal of Operations & Production Management*, 25(5/6), 449-468.

Critical Review Triple Helix to Qunto-Tuple Helix: Lesson Learned from Social Security System Act Implementation

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Abstract
Poverty is still a problem in Indonesia, often causing the exclusion of access to health care in the community under the middle. This prompted the need for the fulfillment of social security policy that can guarantee health care to the entire community, without the exception. In fact, the national social security system in Indonesia has not provided answers to the demands of the aspects of social security. This led to discussion of the draft Law of the National . Social Security System in Indonesia is considered to have a tremendous impact (extraordinary impact) in responding to issues of national social security compliance in the healthcare field. In fact, after this Act has been enacted into Law UU No 24 Tahun 2011, It still leaves homework to implement it by BPJS for Health, which is has to be implemented no later than January 1, 2014. This study describe collaboration model between three sectors namely triple helix as collaboration between academician, business, and government.

The legitimation of this policy, showing not only the triple helix, but it appears the legilsative body as a force qudro helix. Besides academician (researcher, University of Indonesia), business (PT.Askes and PT.Jamsostek as the profit center company engaged in the health and labor) and government (Ministry of Health, Ministry of Social Affairs, Ministry of Labour and Ministry of Finance), then DJSN - who represented, academicia, bureaucrats, NGOs and health workers as well as the House of Representatives would be the force that makes this policy has added value. This study raised the fulfillment of the national social security health of the post positivist approach Scenario Planning method to the National Social Security Health System by 2020. This study analyzes the uncertainty of the future, therefore, in building planning scenarios there is often an alternative scenario. With post positivist paradigm, this study conducted through Focus Group Discussion (FGD), in-depth interviews and secondary data collection. The result of the research shows that there are two scenarios the national social security health system that is optimistic and pessimistic scenarios. Three strategy can be done by stakeholders are leading sector enactment, interest synchronization, and law and enforcement. The result scenario is expected to be used to formulate a strategy for national social security health system as a model approach to learning and recommendations quinto-tuple helix.
Keyword: *Social Security, Scenario Planning, Quinto-Tuple Helix*

THE RELEVANCE OF FORESIGHT FOR EMERGING ECONOMIES

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Abstract
This article offers lessons for emerging economies based on current foresight activities in Central and Eastern European countries. The central theme is the potential use of foresight in decision-making. Foresight can be a relevant decision-preparatory tool in a number of policy fields – well beyond science and technology. Hence, a typology of foresight programs is introduced, distinguishing those focusing on pure S&T, techno-economic and societal issues. It is also claimed that Foresight is a relevant decision-preparatory tool in emerging economies, too, not being in the forefront of technological development, while barriers are acknowledged. As co-operation among emerging countries in designing and running foresight programs can lower these barriers, possibilities for, and advantages of joint efforts are also discussed, and various ways of collaboration are recommended.

Keywords: Building trust; Creating shared visions; Strengthening National Innovation Systems; Improving STI policies

1. Introduction

The increasing number of foresight programs – that is, systematic, participatory processes, collecting future intelligence and building medium-to-long-term visions, aimed at influencing present-day decisions and mobilising joint actions [1] – suggests that foresight can be a useful policy tool in rather different national innovation systems. Emerging economies – faced with a number of similar or same challenges when trying to find their new role in the changing international settings, while still characterised by their own distinct level of socio-economic development, set of institutions, and culture in a broad sense – can also benefit significantly from conducting foresight programs.

This paper is aimed at offering lessons for emerging economies derived from current foresight activities in Central and Eastern European countries [2], [3]. The central theme is the potential use of foresight in decision-making, either for government policies (at various levels) or for strategies of various types of organisations, including businesses. In other words, foresight is a decision-preparatory tool, not a scientific discipline – although it draws on the results and conclusions of scientific projects, as well as relies on a number of scientific methods. It also should be understood that a clear separation should be maintained between the responsibilities (roles, competences) of decision-makers, on the one hand, and participants (or organisers) of foresight programs, on the other. The former ones, as their name suggests, make decisions, e.g. on policies or strategies, public or private actions, budgets, regulations and other rules, etc.; while the latter ones provide inputs to the decision-making processes, in the form of analyses, lists of suggested actions, and other recommendations. Yet another level is the competence of international organisations to 'nurture' foresight activities in emerging economies by organising awareness raising events, contribute to capacity-building, commission various studies on foresight, or co-fund cross-border foresight programs. Again, it is different from the roles and responsibilities of national governments, businesses, experts, NGOs and other representatives of the civil society.

Foresight programs do not have a single, all-encompassing theory to support them, and thus they rely on a range of – somewhat overlapping – theories and methods, including (i) evolutionary economics of innovation; (ii) sociology of science and technology; (iii) actor - network theories; (iv) political sciences analyses of policy processes; (v) communication, co-operation, and participation theories; (vi) decision-preparatory and future-oriented methods, techniques. This list is far from exhaustive, and most likely disciples of these theories would change the grouping, the order of their own discipline or even the wording used here. That might be an interesting discussion in its own right, indeed, for theoretical purposes. Yet, the intention here is just to indicate the 'eclectic' – and thus complex – nature of foresight programs, rather than attempting to provide a meticulous, comprehensive treatise of these issues.

The article draws on the conceptual framework offered by evolutionary economics of innovation [4], [5], [6], because this theory provides useful observations to appreciate the relevance of foresight programs from different angles. First, foresight (programs), future, change, innovation and uncertainty are closely interrelated notions – and some of these are the underlying terms of evolutionary economics of innovation, too. Second, foresight programs are important policy tools, and thus the nature of policy formation processes and the policy rationale of foresight programs should be clearly understood (further explored in Section 2).

The remainder is organized as follows: first the rationale of conducting foresight is presented in Section 2: what policy challenges can be tackled by applying foresight in emerging economies? Besides foresight, there are a number of other methods, approaches to provide future-oriented analyses, and more recently the crucial differences among these approaches are not always clearly understood. This confusion can pose significant challenges, e.g. unrealistic expectations by decision-makers. Thus, Section 3 puts foresight onto this map, and highlights three distinctive characteristics of foresight programs: action-oriented, participatory and consider alternative futures. It is also of crucial importance to appreciate that foresight programs can have different policy rationales (i.e. they can be aimed at tackling different types of policy challenges), and their focus, therefore, can differ significantly. Three of these different types (foci) of foresight programs are discussed in Section 4. Emerging economies have scarce financial resources to fund foresight programs, and relatively little experience in conducing them. International collaboration may ease these scarcities .The benefits of, and potential for, co-operation among emerging economies are thus considered in Section 5. The final section summarises the major conclusions, and presents policy recommendations.

The paper draws on a number of sources: the literature on economics of innovation, which is still somewhat separated from the empirical and theoretical writings on foresight [7], [8]; the experience of several foresight and STI policy practitioners and analysts – shared at a number of international workshops and conferences organized over the last 15 years –, as well the practical experience of the author in conducting and advising foresight programs. (An extensive list of the relevant literature is provided in the longer version of the article.)

8.

2. Policy challenges: why to conduct foresight in emerging economies

A number of technological, economic, societal, political and environmental trends affect all countries and most areas of policy-making, thus a new *culture of future-oriented thinking* is needed. Foresight can assist policy processes in various ways. It stresses the possibility of different future*s* (or future states), as opposed to the assumption that there is an already given, pre-determined future, and hence highlights the opportunity of shaping our futures. Further, it can enhance flexibility in policy-making and implementation, broaden perspectives, and encourage thinking outside the box (‘think of the unthinkable’). In addition, it can reduce technological, economic or social uncertainties by identifying various futures and policy options, make better informed decisions by bringing together different communities of practice with their complementary knowledge and experience, obtain public support by improving transparency, and thus improve overall efficiency of public spending.

Most emerging economies need to (a) find new markets by enhancing international competitiveness; (b) improve quality of life; and (c) turn brain drain into brain circulation. These all point to the need to devise a sound, appropriate innovation policy, and strengthen their national systems of innovation. Foresight can be an effective tool to embark upon these interrelated issues, too, if used deliberately in this broader context.

Foresight can also contribute to tackle yet another challenge of emerging economies: most of them are struggling with ‘burning’ short-term issues – such as pressures on various public services, e.g. health care, education, pensions and thus severe budget deficit; imbalances in current accounts and foreign trade; unemployment; etc. – while faced with a compelling need for fundamental organisational and institutional changes. In other words, short- and long-term issues compete for various resources: capabilities (intellectual resources for problem-solving); attention of politicians and policy-makers who decide on the allocation of funds; and attention of opinion-leaders who can set the agenda (and thus influence discussions and decisions on the allocation of funds). These intellectual and financial resources are always limited, thus choices have to be made. A thorough, well-designed foresight process can help identify priorities, also in terms of striking a balance between short- and long-term issues.

Further, foresight can offer additional process benefits in the CEE countries. By debating the various strengths, weaknesses, threats and opportunities of a country posed by the catching-up process, and the role of universities and research institutes in replying to those challenges, the process itself is likely to contribute to realign the S&T system (including the higher education sector) to the new situation. An intense, high-profile discussion – in other words, a wide consultation process involving the major stakeholders – can also be used as a means to raise the profile of S&T and innovation issues in politics and formulating economic policies. [9]

3. Locating foresight programs among future-oriented analyses

Decision-makers, experts and laymen in different historical periods and in different socio-economic systems shared at least one desire: to know their future in advance or even to influence it for their advantage. They used very different approaches and methods from spiritual/ religious ones to scientific investigations and various modes of planning. It is worth recalling some of the major approaches in order to locate – and distinguish – foresight programs:

- visionary thinking
- forecasting
- futures studies (for academic purposes)
- prospective analyses (for business or policy purposes, e.g. [technology] roadmapping, list of critical/ strategic/ key technologies)
- strategy formation (at firm, sectoral, regional or national levels)
- scenario planning (at a firm level)
- indicative national planning
- central planning (at a national level)
- foresight programs.

Obviously, the above approaches have a number of common characteristics. All of them (a) deal with the future(s) in one way or another; (b) collect and analyze various pieces of information, and (c) can apply a wide range of methods, mainly scientific ones. Three key features can be used to differentiate the above approaches, and thus distinguish foresight programs from other methods. These approaches can:

- be action-oriented vs. 'contemplative' (passive)
- be participatory vs. non-participatory
- consider alternative futures vs. a single future state (already 'set' by external forces).

Action-oriented endeavours aim at shaping/ influencing/ acting upon the future, while passive ones are 'contemplating' about it (e.g. 'pure' futurologist studies, without any policy implications). In other words, the latter ones merely try to develop a better-informed anticipation of the future, e.g. for being better prepared by having more precise information.

Participatory future-oriented programs/ projects meet all the three following criteria: they (i) involve participants from at least two different stakeholder groups (e.g. researchers and business people; experts and policy-makers; experts and laymen); (ii) disseminate their preliminary results (e.g. analyses, tentative conclusions and policy proposals) among interested 'non-participants',[95] e.g. at face-to-face at workshops, via the internet with free access for everyone, or in the form of printed documents, leaflets, newsletters; and (iii) seek feedback from this wider circle (again, either face-to-face or in a written form). Conversely, if any of these criteria is not met, that activity cannot be regarded a participatory programme or project.

Finally, certain approaches are based on the assumption that the future is not pre-determined yet; and thus the future can evolve in different directions, to some extent depending on the actions of various players and decisions taken 'today'. In other words, there is a certain degree of freedom in choosing among the alternative, feasible futures, and hence increasing the chance of arriving at the preferred (selected) future state. Clearly, there is a close link between being action-oriented and considering alternative futures.[96] Other approaches, on the contrary, can only think of a single future, already 'fixed' by certain factors, and thus the task is to explore (forecast, predict) 'the' future scientifically.

In sum, foresight programs are action-oriented, participatory and consider alternative futures.

4. A typology of foresight programs

Foresight programs may have rather dissimilar foci, ranging from the identification of priorities in a strict S&T context to addressing broad societal/ socio-economic challenges. Three 'ideal types' of foresight programs can be defined as major 'reference points'. Identifying 'ideal types' is a long-established practice in social sciences (and somewhat similar to 'models' used in all fields of sciences): "The fact that none of these three ideal types (…) is usually to be found in historical cases in 'pure' form, is naturally not a valid objection to attempting their conceptual formulation is the sharpest possible form."[97] [10]

Note, however, that all three ideal types of foresight programs should meet the criteria defined above in Section 3: they should be action-oriented, participatory and should consider alternative futures. The underlying difference among them is their focus:

- S&T issues: type A foresight programs

[95] 'Non-participants' are those persons who have not been members of panels or working groups set up by the programme, and have not been involved directly in any other way, e.g. by answering (Delphi) questionnaires.

[96] Some foresight programs, e.g. the second Swedish Technology Foresight Programme, consider alternative futures with the explicit aim of identifying key choices confronting their 'constituency' or 'target audience', but do not intend to single out any preferred future. In other words, these programs do not follow a normative approach.

[97] It is just a coincidence that Weber also talks of three ideal types when discussing legitimate authority.

- techno-economic issues: type B foresight programs
- broad societal/ socio-economic issues: type C foresight programs.

Their further characteristics, in terms of their aims, rationales and participants, are summarised in Table 1. One would notice immediately that these ideal types are not distinguished by their themes (topics): for example, they all deal with S&T issues, but by doing so, they pursue different aims, and follow different (policy) rationales. In other words, they address different challenges, ask different questions, use different approaches, and involve different participants. In other words, these ideal types should not be thought of as “Russian dolls”: the biggest one, type C incorporating the middle one, i.e. type B, and, in turn, type B encompassing the smallest one (the ‘core’), Type A.

Table 1. Foci of foresight programs

	S&T focus (type A)	Techno-economic focus (type B)	Societal/ socio-economic focus (type C)
Aims	Identify S&T priorities (following the logic of scientific discovery)	Identify research topics in S&T, of which results are believed to be useful for businesses	Identify research topics in S&T, of which results are believed to contribute to addressing major societal/ socio-economic challenges Devise other policies – or identify policy domains, which are relevant – to tackle these societal/ socio-economic issues
Rationale	Boost national prestige, achieve S&T excellence; Socio-economic benefits might also be assumed; implicitly or explicitly	Business logic: improve competitiveness Correct market failures	Improve quality of life (enhance competitiveness as a means for that) Correct systemic failures, strengthen the National Innovation System
Participants	Researchers, policy-makers (e.g. S&T and finance ministries)	Researchers, business people, S&T and economic policy-makers	Researchers, business people, policy-makers, social stakeholders (lay persons?)

Potential users of foresight results usually constitute a broader group than the actual participants; they might include e.g. funding organizations, other policy implementation bodies and public service providers, professional associations representing the interests of their members (and thus involving them to some extent in strategy and policy formation processes), venture capitalists, trade unions, etc. Depending on the focus of a foresight program (the types of challenges/ issues considered), as well as the political culture of a given country or region, some of these potential users and stakeholders might become participants, too. In any case, it is not possible to establish a one-to-one relationship between an ‘ideal type’ of foresight and its participants beyond the ‘typical’ participants indicated in Table 1. The type and number of participants, the methods, and channels for dialogues, as well as the intensity, quality and impacts of these dialogues is obviously a question for the description, analysis or evaluation of actual foresight programs.

Types A and B programs have a longer tradition, and thus in general they are better known. Obvious examples are the Turkish Vision 2023 Project (type A) [11] and the first UK Foresight Programme (Type B) [12].

Therefore, only type C programs are explained here in some detail. The shift in focus is reflected in the structure, too: these programs are organised along major societal/ socio-economic concerns (e.g. health, ageing population, crime prevention in the case of the Hungarian, the first Swedish or the second UK foresight programs). A new element in the underlying rationale can also be discerned, the so-called systemic failure argument: the existing institutions (written and tacit codes of behaviour, rules and norms) and organisations are not sufficient to improve quality of life and enhance competitiveness, and thus new institutions should be ‘designed’. In other words, the existing gaps should be bridged by new networks, appropriate policies aimed at correcting systemic failures, and establishing or strengthening relevant organisations. A foresight programme, based on this rationale, can deliver solutions in various forms: by strengthened, re-aligned networks as ‘process’ results of the programme, as well as by policy recommendations (‘products’).

An actual foresight programme is likely to combine certain elements from various types. In most cases, however, one type of rationale would be chosen as a principal one; it thus would underlie the more detailed objectives and structure of a programme, as well as the choice of its participants. Otherwise, it would likely to lead to an incoherent – even chaotic – exercise, characterised by tensions between (a) the various objectives, (b) elements of its structure, (c) the objectives and methods, (d) the participants and objectives, and/or (e) among the participants themselves. A certain level of tension, however, might be quite useful – or even essential – to produce creative, innovative ideas and solutions, of course, but too intense and too frequently occurring – structural, inherent – conflicts would most likely tear a foresight programme apart.

5. Possibilities for international co-operation

1.1 Scope and types of co-operation among emerging economies

There is an obvious scope for co-operation among emerging economies. A large number of these countries are relatively small, and have not accumulated much experience with foresight, while facing a number of similar structural challenges. Thus, it can be extremely useful to exchange experiences on methods applied in various countries, as well as identifying success and failure factors. Moreover, some analytical activities on issues going beyond national borders might also be harmonized. In other words, co-operation cannot, and should not, be imposed upon any group of emerging economies. However, various international organizations, as well as national governments and professional associations might play a crucial role in facilitating this co-operation, contributing significantly to achieve synergies and economies of scale.

A well-designed co-operation among the players would assist local (national) capacity building and regional (trans-border) networking. It can take different forms, and the subject and degree of co-operation is likely to vary project by project. The overarching objective should be facilitating future co-operation among major players by establishing good, mutually beneficial working relations, i.e. building trust through actual co-operation during the national/ regional foresight programs.

We can think of three broad types of international co-operation. The obvious possibilities for *methodological* co-operation are as follows:

- informal or semi-formal methodological co-operation: transfer of methodological experience/ expertise at face-to-face meetings, discussions, seminars organised for the clients, participants;
- formalised methodological co-operation: following the same set of methods, e.g. in the frame of a project, but not aligning the content/ substance of the programme.

In either case, the main objective should be to promote interactive learning through joint, tailored workshops (i.e. not a one-way flow of codified knowledge at traditional training seminars) to develop skills and generate shared tacit knowledge. The most important issues are the benefits and drawbacks of various foresight techniques (methods) in the context of catching-up.

A second type of regional co-operation would produce *joint background analyses*, in order to exploit economies of scale (compensating for insufficient intellectual resources in highly specialised fields, be they technical, socio-economic or policy expertise). Some possibilities to kick-off this type co-operation are:

- producing (commissioning) joint background studies on major technological and socio-economic drivers (relevant for the co-operating countries). More in-depth, context- specific analyses, of course, should be conducted and policy conclusions should be drawn as part of the national foresight programs.
- devising scenarios on European/ global developments (if scenarios are to be used in the various national programs);
- building partially aligned scenarios (the structure of scenarios might be partially co-ordinated, in other words some 'variables' might be the same, while their actual 'value' would differ country by country).

The third type of international co-operation is the most ambitious one, when the *themes/ issues* of actual foresight programs are 'aligned':

- jointly designed, simultaneously run national/ regional programs, analyzing the same or similar topics/ themes and applying the same methods, relying on nationally/ regionally organised panels, working groups, etc. In this case, comparative analysis of results might be conducted at the end of the programme (nationally and/or by a small, international group of experts).
- truly co-operative, jointly designed, organised and financed multi-country [or inter-regional] programs, analyzing one set of topics/ themes (at a multi-country 'regional' level, i.e. not for separate countries or 'intra-country' regions) and applying one set of methods, involving participants from a number of countries, who are working closely together, e.g. as members of the same panel, and producing and analysing the findings together, during programme as a core activity (as apposed to the above type, when this analysis is a separate, 'optional' activity).

This type of co-operation would address jointly identified trans-border issues, e.g.

- issues of relevance for a number of countries or cross-border regions: enhancing competitiveness by building/ strengthening clusters, synergies among firms, regional S&T base, and higher education; tackling environmental, region-specific health problems, etc.
- 'emerging-country' problems, such as critical mass in RTDI; the role of, and opportunities for, emerging countries in international co-operation and global production networks/ value chains.

Once co-operation starts, other issues to be discussed jointly and further possibilities for building capabilities and sharing resources, exploiting economies of scale are likely to be identified by the participants themselves. In other words, any rigid 'blueprint' for this co-operation might be counter-productive: insisting on a detailed plan (methods and milestones) might cause more harm than good.

International co-operation, however, poses a significant challenge, too: the broader the geographic scope of a program is, the more difficult and costly is to maintain its participatory character. Moreover, when participants are coming from different countries – in terms of level of development, ways of thinking, norms, values, behavioral routines – it is not only a question of travel time and costs to organize and facilitate meaningful workshops. Potential communication problems should be taken into account carefully when preparing these meetings: possible gaps should be identified in advance, and efforts have to be made to bridge them as well as to remove other obstacles to fruitful discussions. Of course, not all the problems can be envisaged, i.e. some 'slack' (e.g. extra time for clarification, reconciliation, other means to exchange ideas) should be allowed for that.

Another important direction to advance methodology – mainly via experimentation, i.e. including 'action research' – is to develop and test various methods e.g. for virtual meetings; electronic discussions; arranging and exploiting feedback from a series structured, 'aligned' meetings held separately across various countries on the same set of problems (allowing for somewhat different approaches, and yet following the same broad lines of discussions); on-line questionnaires with (almost) real-time ('instant') feedback; etc.

1.2 Recommendations for regional co-operation among emerging economies

The objectives of regional co-operation among emerging economies could include: (a) raising awareness of foresight for enhancing competitiveness by exploiting emerging and future trends in science and technology, and thus contributing to improved quality of life; (b) adopting and adapting methodologies and tools for foresight in the region, and develop/ test methods required by international co-operation; (c) establishing and strengthening national and regional knowledge as well as the capability of using foresight for designing policies and strategies that focus on innovation; (d) initiating regional foresight projects on specific sectors or themes so as to demonstrate its relevance, as well as the practical use of various methods, program design and execution, etc; and (e) offering solutions to relevant problems in a group of countries that can be addressed through the appropriate application of S&T results.

Nevertheless, it has to be taken into account that many foresight programs are undertaken with the assumption that specific technological developments take place within the borders of socio-economic systems, and its effects should be beneficial to the society. This means that final policy decisions will always have a national (or intra-country regional) character, since it is at this level that strategic political or business decisions are made.

As discussed above, however, international co-operation, can be highly beneficial, particularly for emerging economies. Thus, there are several reasons that justify co-operation among emerging countries. In other words, the principle of *'variable geometry'* is to be followed: the geographic coverage of actual projects would depend on the nature of the issues to be tackled, the willingness of countries to participate, their skills, financial and intellectual resources, and most importantly the perceived benefits of the project.

The major benefits of being engaged in regional foresight programs are as follows:

- tackling issues of regional (trans-border) character jointly, and thus creating shared visions and opportunities for joining forces for strategic actions, including regional RTDI co-operation;
- compensating for underdeveloped or lacking methodological skills;
- creating synergies (both in terms of conducting actual foresight projects, and implementation of the policy recommendations);
- saving costs (by exploiting economies of scale, e.g. background analyses and preparatory activities relevant for a group of countries, regions, as well as common awareness building and training);
- capacity building (foresight and prospective analyses methods, decision-preparation, policy-making; policy implementation);
- promoting regional (trans-border) networking;
- reaching the required number of experts when collecting their opinion.

Notwithstanding the advantages of the regional approach, as already stressed, it cannot be imposed upon the partners. It can only be applied in a ‘demand-driven’ manner and when and where its implementation is feasible, and the socio-economic situations among the respective countries are relatively comparable.

2. Conclusions and policy recommendations

Decision-makers face increasingly complex issues, given that economic, technological environmental – and thus social – challenges are brought to any nation sate rather quickly, due the forces of globalisation, and these challenges are usually inherently inter-linked. Technological changes cause economic, environmental and social threats and opportunities; economic resources are required to finance public policies aimed at tackling these issues (e.g. harnessing technological change, preventing environmental crises and social explosions, etc.); and government policies are under ultimate social control (in democratic societies through a number of institutions, formal and direct, as well as informal and indirect ways, in other cases by more costly, more radical, yet, less frequently applied mechanisms).

Both theoretical considerations and actual cases clearly show that foresight can be a relevant decision-preparatory tool in a number of policy fields – well beyond science and technology. In other words, it is time to embrace this broader notion of foresight. This article has attempted to contribute to the diffusion of this new understanding by distinguishing and discussing three different foci of foresight programs, namely pure S&T, techno-economic and societal/ socio-economic ones.

Foresight processes can assist decision-makers in this complex environment to reduce technological, economic or social uncertainties by identifying various futures and policy options, make better informed decisions by bringing together different communities with their complementary knowledge and experience, obtain public support by improving transparency, and thus improve overall efficiency of public spending.

It is crucial to prove the relevance of foresight for decision-making: its timing and relevance to major issues faced by societies, as well as the quality of its ‘products’ – reports and policy recommendations – are critical. Only substantive, yet carefully formulated proposals can grab the attention of opinion leaders and decision-makers, and then, in turn, the results are likely to be implemented. Otherwise all the time and efforts of participants put into a programme would be wasted, together with the public money spent to cover organisational and publication costs. The so-called process results – e.g. intensified networking, communication and co-operation among the participants – still might be significant even in this sad case, but they are less visible, and much more difficult to measure. Thus, the chances of a repeated programme – when it would be due again given the changes in the circumstances – are becoming really thin.

Besides foresight, there are a number of other useful ways, techniques, and methods to assist strategic (long-term) policy processes and strategic decision-making (for businesses). The selection of methods should be based on the policy or strategy issue, i.e. none of these methods is superior to any other ones a priori – the context (challenges to be tackled, resources, competence and time available, etc.) should drive the decision as to what approaches and method(s) are adequate, and hence to be applied.

It is strongly recommended, however, to maintain a clear distinction among the various approaches, ways, methods and techniques aimed at analysing future developments. In other words, confusing foresight with other future-oriented analyses is likely to lead to ill-defined programs, methodological deficiencies, erroneous analyses and flawed proposals. Clients, sponsors, and participants of foresight programs, in turn, would be disappointed, disillusioned.

Foresight is a relevant decision-preparatory tool in emerging economies, too, not being in the forefront of technological development. A number of factors seem to contradict this conclusion at the first glance. Foresight is costly in terms of time and money, but even more so in terms of the participants’ time required by meetings, workshops and surveys. Moreover, advanced countries, whose experts, in turn, know more about the leading edge technologies, regularly conduct their foresight programs, and their ‘products’ – reports, Delphi-survey results – are readily available. Yet, only a national programme can position a country in the global context and spark a discussion on how to react to major trends. Similarly, SWOT of a given country would not be analysed by others, let alone broad socio-economic issues. Process benefits cannot be achieved without a national programme either. Without these, a country would not be able to improve the quality of life of her population and enhance her international competitiveness.

There are even stronger needs for strategic thinking in most emerging economies than in the advanced countries. Yet, long-term thinking might be discredited (e.g. due to the failure of central planning in those countries that attempted to use this tool). In many countries policy-makers do not rely on modern decision-preparatory tools to a sufficient extent, and quite often do not realise the close interconnections between RTDI processes and socio-economic development. Thus, often they are only willing to spend on R&D when "we can afford" – although it should be the other way around: "we spend on promoting RTDI processes, because we want to foster wealth creation". Science, technology and innovation policies are isolated (often the latter one does not even exist as an explicit policy field), and major economic policies are not co-ordinated with STI policies.

For these reasons one can observe strong commitment for profound foresight programs – that is, sound, in-depth consideration and determined implementation of policy recommendations, introducing a new decision-preparatory and decision-making culture, along with a new way of thinking, with more emphasis on communication, co-operation, consensus, and joint commitments to take action – only in a few emerging economies.

International co-operation can raise awareness among the stakeholders, and also enhance the chances of success by sharing lessons, easing the lack of financial and intellectual resources through exploiting synergies and economies of scale. Yet, its more ambitious form, i.e. jointly designed and conducted foresight programs on trans-border issues also necessitates methodological innovations. International organisations can also facilitate foresight programs in emerging countries, and more specifically collaboration among them. It is crucial, however, to maintain the commitment of local actors, e.g. in terms of time and funds devoted to the programme, willingness to implement the results. In other words, the main forms of foreign assistance should be the provision of knowledge-sharing platforms and other fora to exchange experience (among emerging economies as well as with advanced countries), monitoring and evaluating foresight initiatives in the supported emerging countries.

References

[1] FOREN (2001). A Practical Guide to Regional Foresight, Foresight for Regional Development Network, EC, DG Research, Brussels.
[2] Havas, A. (2003). Evolving Foresight in a Small Transition Economy, *Journal of Forecasting*, 22, 179 - 201.
[3] Havas, A. & Keenan, M. (2008). Foresight in CEE Countries, in: *The Handbook of Technology Foresight: Concepts and Practice* (L. Georghiou, J. Cassingena, M. Keenan, I. Miles, & R. Popper) 287-316, Cheltenham: Edward Elgar.
[4] Freeman, C. (1994). The economics of technical change: A critical survey. *Cambridge Journal of Economics*, 18, 463 - 514.
[5] Fagerberg, Jan, David C. Mowery & Richard R. Nelson (Eds.) (2005). *The Oxford Handbook of Innovation*, Oxford: Oxford UP.
[6] Nelson, R.R. [1995]: Recent evolutionary theorizing about economic change, *Journal of Economic Literature*, 33, 48 - 90.
[7] Georghiou, L., Cassingena H., J., Keenan, M., Miles, I., & Popper, R. (Eds.) (2008). *The Handbook of Technology Foresight - Concepts and Practices*, Cheltenham: Edward Elgar.
[8] Martin, B. & Irvine, J. (1989). *Research Foresight: Priority-setting in science*. Pinter Publishers: London and New York.
[9] Georghiou, L. (2002). Policy rationales, sponsors and objectives, presentation at the eFORESEE Workshop on Foresight Basics, Malta, 24-26 July 2002.
[10] Weber, Max [1947]: Legitimate Authority and Bureaucracy. In The *Theory of Social and Economic Organisation* (translated and edited by A.M. Henderson and T. Parsons), pp. 328-340, Free Press; reprinted in D.S. Pugh (Ed.) (1985). *Organization Theory: Selected readings*, pp. 15-27, London: Penguin Group.
[11] Saritas, O., Taymaz, E., & Tumer, T. (2007). Vision 2023: Turkey's National Technology Foresight Program: A contextualist analysis and discussion. *Technological Forecasting and Social Change*, 74, 1374 – 1393.
[12] Georghiou, Luke [1996]: The UK Technology Foresight Programme, *Futures*, Vol. 28, pp. 359-377

EXPLAINING DIFFERENT MODES OF INTERACTION UNIVERSITY-ENTERPRISE-GOVERNMENT TO ENHANCE INNOVATIONS: CASE STUDIES OF BRAZILIAN FIRMS

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Abstract
Triple Helix model (THM) emphasizes the role of the interaction played between universities, public institutions and firms in fostering innovation. However, this interaction requires some effort and interest of all parties involved. The purpose of this paper is to identify main features of the tripe-helix interaction in four firms from different Brazilian industries. Preliminary findings suggest that, based on symmetric/asymmetric information, the firms' decision of innovation partnering with universities and governmental entities depend on innovation capabilities available in the firm, which are directly linked to the features of the industry. Findings suggest that, under the THM, firms can perform four possible behaviors. Based on perfect information about the innovation partnership possibilities under the THM and the potential benefits, firms could decide: a) Not to interact, because the cost-benefit analysis is negative; b) Interact, because the cost-benefit analysis is positive. And based on imperfect information, firms could decide: c) Not to interact, because managers or owners are not aware about the innovation partnership possibilities and its benefits; and d) Interact, but without being totally aware about the innovation partnership possibilities and its potential benefits. The study intends to provide useful information for a better understanding of firm's behavior under the THM. Findings suggest that policy makers, when promoting innovation in the Brazilian context, could have the possibilities to make better decision in resource allocation.

Keywords: Innovation Capablities, Triple Helix Model, Firm's behavior, Brazil

Promoting Innovation on Disaster-related Issues in Developing Countries

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ABSTRACT

In this paper, innovation system approach in the disaster issues is exposed focusing on developing country like Indonesia. From science and technology point of view, shifting the disaster management paradigm from emergency to prevention will require greater involvement from the innovation role. It is recognized that part of the prevention phase which has the highest science and technology content is the early warning systems. In terms of Indonesian Tsunami Early Warning System (InaTEWS), the promotion of innovation is urgently needed to maintain the sustainability of the systems and which in turn able to contribute positive impact to the economy of the nations. Therefore, a new approach for promoting innovation in disaster managementshould be examined.

Keywords: *disaster, early warning system, sustainability, innovation, detecting equipment*

1. Introduction – Plate Tectonic

The location of Indonesia on the Pacific "Ring of Fire" and lies at some boundaries of tectonic plates: Eurasia plate, Indo-Australia plate, and Pacific plate, makes it prone to natural disasters. According to USGS (2009), about 90% world's earthquakes occurred there. The tectonics processes in Indonesia formed major structures in Indonesia. The most prominent fault in the west of Indonesia is the Semangko Fault, a dextral strike-slip fault along Sumatra Island. The formation of this fault zone is related to the subduction zone in the west of Sumatra.The complication of the plate movement in Indonesia arises from collision among four plate tectonics in subduction zones, which become the location for earthquake generation, and subsequently may trigger tsunamis.In 2004, a massive 9.1 magnitude earthquake struck the coast of Aceh and caused a devastating tsunami. In this event, 165,708 people perished and the material loss was calculated to be US$4.45 billion. For countries like Indonesia, it is very important to develop strong relationship between geological condition and innovation systems in order to make the most of situations for developing economy in the country.

2. Indonesian Tsunami Early Warning Systems (Ina-TEWS)

Prior to the 2004 Aceh tsunami, in Indonesia there were limited infrastructures to provide tsunami early warning. The warning requires about 30 minutes elapsed time before it could be issued and disseminated. This left only very little time for evacuating people in the affected coastal areas. Driven by 2004 disaster, Indonesia had begun setting up early warning system which was launched in 2008. Indonesian Tsunami Early Warning System (InaTEWS) is set up to produce tsunami warning in 5 minutes after the earthquake.

The event prompted the Government of Indonesia to develop the Indonesia Tsunami Early Warning System (InaTEWS), which networked several types of equipment. Endless efforts in community preparedness were expected to be integrated into the system in order to develop an end-to-end tsunami warning. Therefore, Ina-TEWS consists of two major components, i.e., structure and culture, as can be seen in Figure 1.

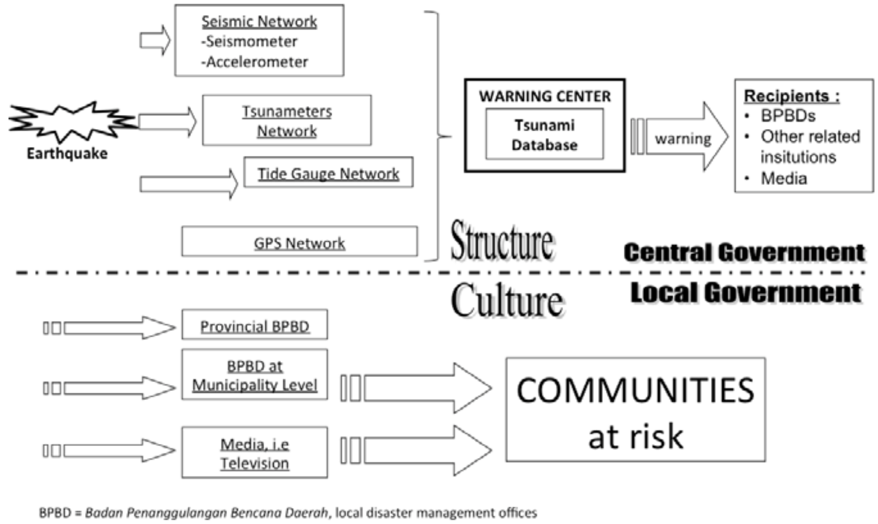

Figure 1. Components of InaTEWS

a. Structure Components

The structure component is related to the installation of seismic, crustal movement and tsunami monitoring system to produce data for the early warning system for tsunami. The warning is then delivered to institutions interface, which consists of provincial and district/municipal governments, mass media, and high-ranking officers in the central government. The related institutions then disseminate the warnings to the communities at risk. The latter is termed as the culture component.

The structure component involves several types of equipment to facilitate redundant systems. Detecting signals of tremors as well as the occurrence of tsunami at seabed, carrying the signals to the sea surface, and further transmitting them via satellite to the National Tsunami Warning Center (NTWC) requires a great efforts. In NTWC, which operates 24/7, such data are processed to compose warning messages, which are then sent to related institutions, especially provincial and districts/municipal governments, as mentioned previously. At this stage, the task of structure components is terminated and handed over to the culture components.

b. Culture Components

The culture component is apparently more complex as it is concerned with human behavior in the reaction to warning. This component focuses on how community should perform the intended response to the warning. While the structure component can be considered to be finished once the equipments have been installed (keeping in mind that operation, maintenance, and development should be carried out in order to guarantee its sustainable operation), culture work should be sustained by repeating exercises, simulations, and drills.

However, in a later stage, the promotion of innovation in this regard is urgently needed to maintain the sustainability of the systems. Therefore, the economy induced by disaster activity can be initiated. In other words, disaster issues should also be able to propel direct and/or indirect economic activity in the society.

3. Twin Earthquakes, 11 April 2012

On April 11th, 2012, a magnitude 8,5 earthquake struck off the western coast of Indonesian island of Sumatra. The earthquake was traced at 3:38 pm local time to a depth of 10 km and 398 km southwest of Banda Aceh. The slippage occurred in a fracture in a slab of oceanic crust that is bending downwards and beneath Sumatra. This earthquake then followed by a magnitude 8,1 aftershock which was measured to a depth of 24 km with the distance of earthquake's epicenter was 552 km away from Meulaboh. Unlike the earthquake that triggered the devastating tsunami in 2004, on the occassion, the sea floor moved sideways instead of vertically, meaning it displaced less water and did not send giant waves around the Indian Ocean.The warning buoys as part of InaTEWS which were installed after the 2004 disaster, detected tsunami soon after the earthquake, but the highest waves that reached the nearby shoreline of Sumatera were measured only 80 cm. The dissemination of tsunami warning was launched by BMKG around 4 minutes and 54 seconds after the first earthquake, then lifted four hours afterwards.

It is interesting to note, that the size of the quake and the motion of the ocean floor are regarded odd, and make it "something new" for geological science (Okal, 2012). First, the earthquake did not occur at a subduction zone, where tectonic plates collide and one dives beneath the other into Earth's mantle. On the contrary, the earthquake happened about a hundred miles from the nearest subduction zone, making the temblor an "intraplate" quake. Intraplate quakes tend to be much smaller. The combination of these two factors, both the high magnitude for an intraplate quake and its strike-slip nature, makes the earthquake unique and intriguing because it is something that has been never seen before.

4. Innovation Systems

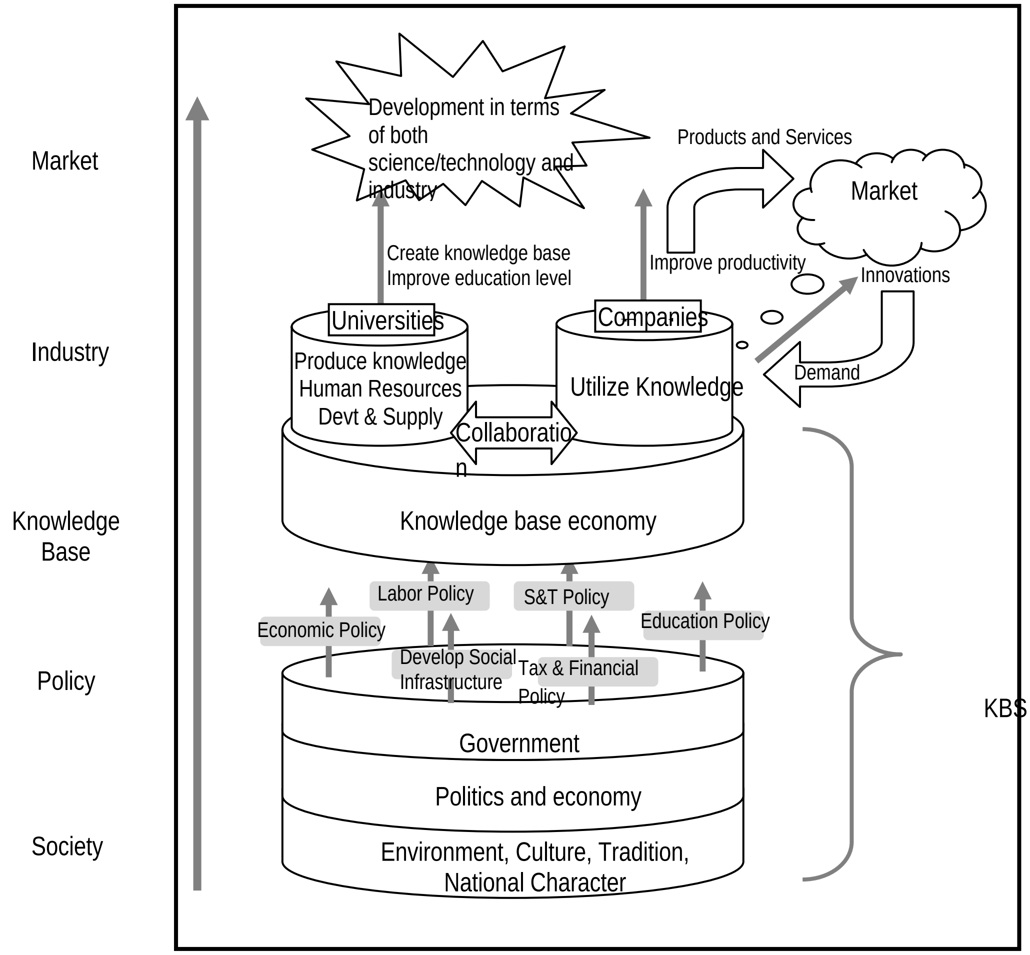

Figure 2. Conceptual Diagram of National Innovation System
(MEXT, 2002)

The Law no. 24 year 2007 that legalized the establishment of a disaster management agency at both national and local level, highlights the importance of science and technology as a basic principle in disaster management in Indonesia, together with the other seven fundamental considerations. The spirit contained in the law is prioritized the preventive activities rather than emergency actions. This is in-line with the well-known considerations that preventing disaster from happening is very much cheaper than emergency reactions after disaster occurrence. From science and technology point of view, shifting the disaster management paradigm from emergency to prevention will require greater involvement from the innovation role. Furthermore, it is also recognized that part of the prevention phase which has the highest science and technology content is the early warning systems.

World Bank (2010) stated that innovation means technologies or practices that are new to a given society, and being diffused in that economy or society (figure 2). Moreover, what is not disseminated and used is not an innovation.The indirect economic benefit that can be gained from the innovation of disaster management is a safe, secured and protected society. This would lead to the establishment of a conducive environment which indirectly ensures economic stability of the country. On the other hand, the innovation of disaster management can boost direct economic revenue of the society, such as by the development of disaster tourism, natural disaster laboratory, or the production of equipment for detecting disasters. Considering this importance, consequently, a new approach for promoting innovation in order to cope with the disaster problem should be examined.

5. Pilot Projects: Engineering of Tsunami Buoys

A tsunami buoy is a specialized buoy which is able to detect subtle changes in water pressure which could indicate an incoming tsunami. Tsunami buoys are placed at strategic locations to provide early warnings which can be used by authorities to determine the risk of a tsunami. Using data collected from tsunami buoys, authorities may order an evacuation or issue a warning, and they can sometimes estimate the height of the incomingtsunami.In Indonesia, there are several types of tsunami buoys, namely InaBuoy TEWS (Indonesia), DART / DART ETD (USA, Australia, Thailand, India), and GITEWS (Germany). During the period of year 2007 and 2012, Indonesia has been already deployed 25 buoys in Indonesian oceans. However, there were just three buoys in operation, mostly because of vandalism. To cope with this issue, Indonesia has made a new concept of InaTEWS buoys design. Since surface buoys were highly targeted by vandals, the new design involved the combination of Indonesia Cable Based Tsunameter and HF Radar to make a fix buoy.

6. Conclusion

In order to strengthen the performance of InaTEWS, it is important to refer the draft for Presidential Instruction that has been discussed after the Mentawai Tsunami on October 25th, 2010. The discussion involved twenty four ministries and agencise, and all governors and heads/mayors of regencies/municipalities of the areas at risk. The Presidential Instruction deliberated four components, i.e strengtheninng structure part, reinforcing cultural components, promoting capacity building, and designing monitoring and evaluation activities. Regarding the structure parts, it is urgently needed to further develop warning massage. Information in the warning should also include prediction of tsunami wave height and the estimated time of arrival. In addtion, the warning distribution through television should be made more effective and more constructive to its viewers as it had been very effective in disseminating warning (Pariatmono, 2012).

For shelter development, Ministry of Research and Technology along with Ministry of Public Works, National Agency for Disaster Management, and Bandung Institute of Technology had formulated a joint concept of evacuation buildings. It contains a guidance for rapid assessment of building's structure to be designated as an evacuation building. Furthermore, it also explains about the guidance for developing new evacuation shelters of the areas at risk.

In Banda Aceh, there is a centre of excellence named Tsunami Disaster Mitigation Centre (TDMRC) which was appointed by the vice president as the first tsunami mitigation centre in Indonesia. This research centre focuses on the efforts of reducing disaster risk and tsunami with the mission to disseminate the research outcome to be exploited by the community of Aceh, Indonesia and international society. Hence, in the future, the process of capacity building in disaster management should be prioritized for the development of this research centre.

Finally, to stimulate the growth of national industries related to disaster equipments production, either detection tools or emergency equipment, therefore, the synergy of triple helix, which consists of government, academia, and business sector, is needed. In the context of science and technology, the government, whose duty is to protect the society, has two roles in disaster management. Apart from mobilizing experts and human resources in the field of disaster, which include the academia, the government should also play an important role as the primary consumer of disaster detection equipment (for earthquake and tsunami detection, such equipment are accelerometers, seismometers, buoys, tide gauges, sirens, etc).The growing innovation environment also requires academia to focus in conducting research to develop of disaster sensing devices. Encouragement in the form of start-up incentives should be provided to new companies which are developed from the universities. They are expected to be able to play significant role in providing flow of products and services for the government as the prominent market related to disaster issue. With this new approach, therefore, an innovation system to the disaster management can be encouraged, especially in disaster prone countries which in turn able to contribute positive impact to the economy of the nations.

REFERENCE:

[1] Pariatmono. “The Influence of Mentawai Tsunami to Public Policy on Tsunami Warning in Indonesia”, 2012, Journal of Disaster Research Vol. 7 No.1, 2012.

[2] Okal. “No Tsunami? Why Earthquake Spared Indonesia Today”, 2012, http://news.nationalgeographic.com/news/2012/04/120411-tsunami-alert-watch-warning-earthquake-indonesia-aceh-science-/

[3] Wikipedia. “Geology of Indonesia”, 2011, http://en.wikipedia.org/wiki/Geology_of_Indonesia

UNIVERSITY, INDUSTRY, AND GOVERNMENT PARTNERSHIP: ITS PRESENT AND FUTURE CHALLENGES IN INDONESIA

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Abstract

This paper presents the current situation of the university–industry–government partnership in Indonesia, in the context of university readiness to contribute to the government strategy as outlined in the MP3EI (Master plan for Acceleration and Expansion of Indonesia Economic Development) 2011-2025. Since the higher education system is highly diversified in term of its capacity to contribute, the paper reviews the status in 3 different types of institutions: research, production, and human resources development oriented. Initial finding shows that the government allocated very small budget for research (0.08% of GDP) and universities play a critical role in the national research capacity. Although research is still considered as very low in the government priority setting, the number of patents and international publications has significantly increased in the last few years. Collaborative activities have been carried out to date include, service and training, patenting, collaborative R&D, networking events, industrial collaboration for education, incubators, SME support, and science parks. University and industry appear to be still in the state of “institutional sphere” instead of “consensus space” lacking understanding about each other. The uncertainty about institutional framework available for universities drives academics to develop partnership with industries individually instead of institutionally. Universities feel that there are only few domestic companies with interest and/or capacity to innovate, with the bulk of industry concentrated in assembly operations. Implementation of MP3EI outside Jawa might require expertise and capacity that are only available in institutions in Jawa, that it is essential to develop mechanisms for building local institutional capacity. We conclude that all 3 institutional spheres require further development before each can take purposeful action. Having said that, the study team found a number of cases whereby the 3 parties are willing, even eager, to develop partnerships. With an appropriate and comprehensive strategy, there is significant potential to create productive environment to be developed into knowledge, consensus, and innovation space.

Keywords: UIG partnership; Indonesia, MP3EIIntroduction

CONSUMER INNOVATIVENESS IN MOBILE PHONE ADOPTION AMONG INDONESIAN COLLEGE STUDENTS

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Abstract
The fast adoption of mobile phone has been the subject of many empirical studies about the adoption of innovation. This research examines the relationship between general trait innovativeness, domain-specific innovativeness, and single product actualized innovativeness. The authors also investigate the relationship between domain-specific innovativeness and information seeking and price sensitivity. An extended innovativeness model was developed. A structural equation model was used to test the hypotheses using empirical data from 558 respondents of Bandung Institute of Technology, Indonesia in mobile phone context. The results provide support for the hierarchical perspective of consumer innovativeness; domain specific innovativeness mediates general trait innovativeness (subjective knowledge and hedonic-idea shopping) and actualized innovativeness (spending behavior). Domain-specific innovativeness has positive impact on information seeking and price sensitivity. The findings provide an inconsistent relationship between general trait innovativeness and actualized innovativeness. Our findings suggest that mixed influence factor in the adoption of mobile phone.

Keywords: consumer innovativeness, mobile phone, adoption

Introduction

Mobile phone is one of electronic products which growing fast. Thus most device manufacturers are trying to introduce new models to consumers. The mobile market in Indonesia has grown rapidly over the past decade; an increasing amount of Indonesians are making use of mobile phones to do work, communicate or entertain themselves in a free manner capturing immediate acceptance and diffuse rapidly into consumers' live. It is no wonder why Indonesia is by far regarded as the most profitable mobile market in East Asia with the highest mobile subscriber growth in the region. According to The Nielsen Company (2011), Indonesia's mobile phone penetration has increased in the past five years while the number of landlines is declining. A Nielsen digital report showed that Indonesia has emerged as the country with the highest dependence on mobile internet access in Southeast Asia, with almost half of all citizens logging on via their cell phones (Mobile Nation, 2011). Mobile phones have become an increasingly force shaping the lifestyles of consumers. Mobile phones are one of the most prominent examples of such innovations achieving a large penetration rate in many markets.

Consumer innovators are the earliest buyers of new products. The role of consumer innovators in diffusion is important because they provide revenue and feedback to firms launching new products. Successful sales to innovators or early adopters result in market leadership and raise effective barriers to entry which prevent other firms from entering the market. Consumer behavior theorist has given much attention to the issue of understanding innovative consumer behavior. It is inspired by the needs of marketing managers and theoretical concerns. A key issue facing mobile phone marketers is how to find and attract buyers who are aware of presence new model and brand of mobile phones. The problem inspiring the present study is that of investigating the construct of product-category specific innovativeness, the propensity to buy new products from a product field soon after they appear in the market. Marketing managers would like to measure this variable so that they can devise optimal, diffusion-promoting marketing strategies.

Reza and Astuti (2012) examined that integrator perspective model can capture consumer innovativeness in electronic product category. This model found that domain-specific innovativeness as mediator between general trait innovativeness and new product adoption behavior. Further, we would like to examine the relationship between general trait innovativeness, domain specific innovativeness, and single product actualized innovativeness. We choose mobile phone as single product actualized innovativeness. The mobile phone market is one such market; consumers can choose from a large range of comparable prices and most mobile phone manufactures offer a range of product of each competing technology. The aim of this study is to determine which aspects of general trait innovativeness may predict single product actualized innovativeness which in domain specific innovativeness as mediator. We also examine the relationship between domain-specific innovativeness and price sensitivity and information seeking.

Literature Review

General trait innovativeness

The general trait perspective focus on identifying innovative consumers based on their 'innate innovativeness' [Hirschman 1980] or 'innovative predisposition' (Midgley and Dowling 1993), which is similarly defined as a generalized unobservable predisposition toward innovations application across product classes. The concept of innovativeness represents a highly abstract and generalized personality trait [Im, et al. 2003], thus it is free from the context or domain in which consumers are located (McCarthy, et al. 1999). Nasution and Astuti (2012) have explained that variety seeking, subjective knowledge, and hedonic-idea shopping are variables that used to explain general trait innovativeness.

Domain-Specific Innovativeness

Domain-specific is the dimension of consumer innovativeness that reflects the tendency to learn about and adopt innovations within a specific domain of interest and taps a deeper construct of innovativeness more specific to an area of interest (Citrin, et al. 2000). Domain-specific innovativeness captures the individual's predisposition toward the product class and refers to the tendency to acquire new products or related information within a specific domain (Goldsmith and Hofacker, 1991).

Actualized Innovativeness: New product adoption behavior

Actualized innovativeness is best presented by a process of multiple stages through which an individual passes, from first awareness to continued use of the innovation (Rogers, 2003). New product adoption behavior is the extent to which consumers are relatively early in adopting new products than other members of their societies (Rogers, 2003). There are two ways to operationalize innovative behavior using this behavioral perspective. First, is by measuring the relative time of adoption of a specific new product compared with the adoption times of other consumers (Rogers and Shoemaker, 1971). Second, is by measuring spending behavior. A consistent finding in studies of innovative behavior is that innovators are likely to own more products or spend more in a category than non-innovators (Gatignon and Robertson, 1985). Our study uses self-report of both the relative time of adoption (i.e., number of years since adoption) and relative spending behavior (i.e., amount of money spent to buy products).

a. Hypotheses development

Based on previous finding (Nasution and Astuti, 2012), variety seeking, subjective knowledge, and hedonic-idea shopping as constructs of general trait innovativeness that engenders consumers to adopt new product. We next construct a hierarchical model capturing the relationship between various dimensions of consumer innovativeness and different aspects of new product adoption (Figure 1) and discuss various relationships of this model.

Variety seeking and new product adoption behavior

Variety-seeking tendency is rooted in need for a change in an attempt to resolve the boredom associated with a brand and a product (Van et al., 1996). Consumers try to increase stimulation in such situations by seeking something different or new relative to their previous choice (McAlister and Pessemier, 1982; Menon & Kahn, 1995; Van et al., 1996). One important outcome of the variety seeking drive in the context of consumer choice would be the desire for new or novel products manifested by purchase exploration (i. e., switching/innovating. Thus, we hypothesize that:

H1a: General trait innovativeness, variety seeking will be positively associated with new product adoption behavior (time of adoption).

H1b: General trait innovativeness, variety seeking will be positively associated with new product adoption behavior (spending behavior).

Subjective knowledge and new product adoption behavior

Subjective knowledge, that is, perceptions of knowledge, representing what the consumer thinks she/he knows (Brucks, 1985; Park et al., 1994). Subjective knowledge can be measured on a standardized scale (Brucks, 1985). Raju et al. (1993) found that subjective knowledge was a better predictor of purchasing behavior than was objective knowledge. Consumer knowledge has been considered to be one of the more critical factors influencing the new technology adoption process (Gatignon and Robertson, 1985; Mahajan, Muller and Bass, 1995; Moreau, Markman, and Lehmann, 2001; Sheth, 1981]. People with more knowledge about technology are more likely to adopt technology. Hence, we hypothesize that:

H2a: General trait innovativeness, subjective knowledge will be positively associated with new product adoption behavior (time of adoption).

H2b: General trait innovativeness, subjective knowledge will be positively associated with new product adoption behavior (spending behavior).

Hedonic-idea shopping and new product adoption behavior

Roehrich (1994) defines his hedonic innovativeness dimension as the drive to adopt innovations for hedonic reasons, such as to enjoy the newness of the product. Focused on hedonistic shopping motivations, Arnold and Reynolds (2003) developed an 18-item scale and identified six dimensions of hedonic motivation shopping: "Adventure shopping" referred to experiencing a variety of sights, sounds and smells while shopping; "Gratification shopping" involved shopping to relax and to offer a special pleasure to oneself; "Role shopping" revealed the satisfaction of shopping for others; "Value shopping" involved looking for discounts, low prices and sales; "Social shopping" was associated with the satisfaction of socializing; and finally, "Idea shopping" was related with the searching for trends and innovations. In this study we only focus on hedonic-idea shopping which influence on innovative behavior. Hence, we hypothesize that**:**

H3a: General trait innovativeness, hedonic-idea shopping will be positively associated with new product adoption behavior (time of adoption).

H3b: General trait innovativeness, hedonic-idea shopping will be positively associated with new product adoption behavior (spending behavior).

General trait innovativeness - Domain specific innovativeness – New product adoption behavior

The extant literature suggests that domain-specific innovativeness may mediate the relationship between general innovativeness and innovative behavior (Goldsmith et al., 1995; Midgley and Dowling, 1978). Domain-specific innovativeness is probably a consequence of the interaction between general trait innovativeness and strong interest in product category (Goerlich, 1996). Hirunyawipada and Paswan (2006) found that domain-specific innovativeness play an important role in hierarchical perspective of consumer innovativeness, by becoming mediating factors in the relationship between general trait innovativeness and new product adoption. Thus, we propose that:

H4a: Domain-specific innovativeness will mediate the relationship between variety seeking and time of adoption.

H4b: Domain-specific innovativeness will mediate the relationship between variety seeking and spending behavior.

H5a: Domain-specific innovativeness will mediate the relationship between subjective knowledge and time of adoption.

H5b: Domain-specific innovativeness will mediate the relationship between subjective knowledge and spending behavior.

H6a: Domain-specific innovativeness will mediate the relationship between hedonic-idea shopping and time of adoption.

H6b: Domain-specific innovativeness will mediate the relationship between hedonic-idea shopping and spending behavior.

Domain-specific innovativeness and Price sensitivity

Price sensitivity is an individual difference variable describing how individual consumers react to price levels and changes in price levels. A consumer high in price sensitivity will manifest much less demand as price goes up (or higher demand as price goes down), and consumers low in price sensitivity will not react as strongly to a price change (Goldsmith and Newell, 1997). Price has a significant influence on consumers' purchase behavior and consequently on sales and profits of the firm (Han et al., 2001). Previous research has shown that innovators are relatively price insensitive, at least for new restaurant and fashionable clothing (Goldsmith, 1996; Goldsmith and Newell, 1997). While they are involved in getting good deals, this seems to be a result of their interest in the market place and not from price sensitivity per se. Innovators are more interested in acquiring the latest new product regardless of price owning to their involvement in the product category. Thus, we propose the next hypotheses:

H7: Domain-specific innovativeness will be negatively associated with price sensitivity

Domain-specific innovativeness and Information Seeking

Information seeking represents the activities that are carried out during the search for information. An innovative person seeks information actively and has a greater exposure to different media sources (Rogers, 2003). An innovator would be more aware of the available information channel due to greater information seeking, which would be necessary to maintain the quality of being an innovative individual. Innovativeness represents an attitudinal disposition and can persuade and individual to seek information from those channels that increase the awareness and may involve some experimentation and risk taking. Hirunyawipada and Paswan (2006) found that domain-specific innovativeness positively related with acquire information associating with new products. Thus, we propose the next hypotheses:

H8: Domain-specific innovativeness will be positively associated with information seeking.

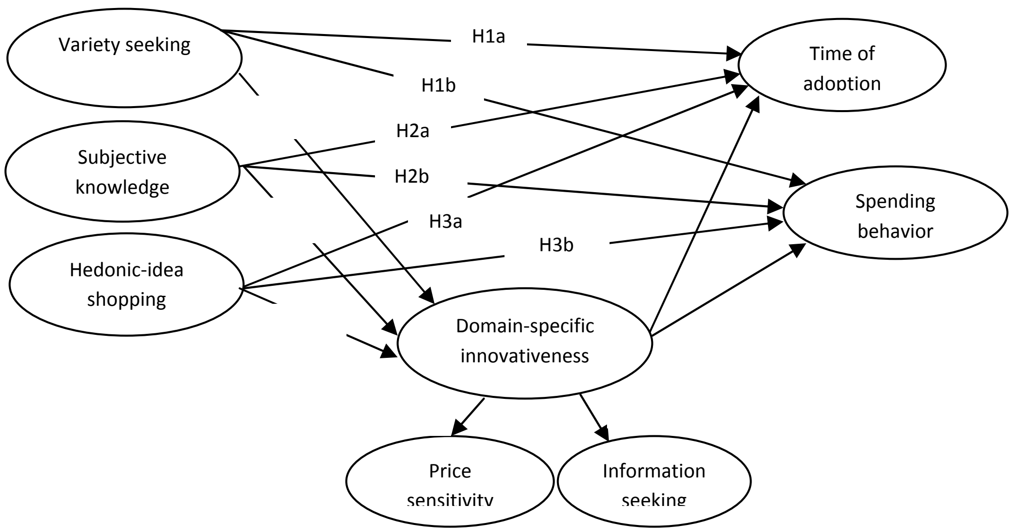

Fig. 1 Consumer innovativeness model

Research method

Research setting, sample, and procedure

This research refers to quantitative approach. Type of survey that used in this study is self-administered questionnaires. Population in this study is undergraduate students in Bandung Institute of Technology.Unit elements in this study are undergraduate students in six-faculties in Bandung Institute of Technology who has interest and experienced with mobile phone. We selected those products because they are fast product life cycles and more personal owned by college-aged students.

Before distributing questionnaire in large sample, we conducted pre-test to 40 respondents in attempt to know their understanding about questionnaires items. We used two-stage cluster sampling to ensure representation from all major academic area within the university. The final questionnaires were administered to 657 respondents. Of the total returned questionnaires 50 responses were in found incomplete, resulting in 607 final usable questionnaires. The participants were male 49.8 percent and female 50.2 percent with a mean age of 18.85 years old (minimum age was 16 and maximum age was 24 years old). 19.6 percent were from School of Electrical Engineering and Informatics department, 18.6 percent were from School of Pharmacy department, 18.1 percent were Faculty of Civil and Environmental Engineering, 17.1 percent from Faculty of Earth Science and Technology, 15.2 percent from School of Business and Management and 11.4 percent from Faculty of Art and Design. 44.8 percent of respondents have an annual income between \$1,200 and \$2,400. Respondents who have an annual income less than \$1,200 is 44.5 percent, between \$2,400 and \$3,600 is 7.4 percent of respondents, and more than \$3,600 is 3.3 percent. 601 respondents or 99% of total respondents have mobile phone which support camera and able to access internet. After we checked normality, multicollinearity, outlier data, only 558 is used in further analysis.

Measures

The survey instrument was originally developed in English and then double-blind-translated into local language (Indonesia) for respondents who were not fluent in English. To achieve comparability, the issue of equivalence of meaning was carefully during translation. The measure consisted of variety seeking (VS), subjective knowledge (SK), hedonic-idea shopping (HE), domain-specific innovativeness (DSI), price sensitivity (PS), information seeking (IS), relative time of adoption (RTA) and relative of spending behavior (RSB). Variety seeking scale developed by Raju (1980), the subjective knowledge constructs are measured with items adapted from Park et al. (1994) and Oliver and Bearden (1983), hedonic-idea shopping items are adapted from Arnold and Reynolds (2003), information seeking items are adaptep by Raju (1980), price sensitivity are measured with items by Goldsmith (1996). For measuring domain-specific innovativeness we use the instrument developed by Goldsmith and Hofacker (1991). With the exception of subjective knowledge with nine-point likert scale, all items are measured with five-point likert scales. Finally, new product adoption behavior is measured from an adapted version of Im et al. (2007).

Data analysis

Confirmatory factor analysis and assessment of validity and reliability

We followed the two-step procedure recommended by Anderson and Gerbing (1998) to establish measurement and structural model. Confirmatory Factor Analysis (CFA) was used to analyze the the convergent validity and discriminant validity of all items of construct using maximum likelihood estimation in Lisrel 8.70 in the analysis. According to the CFA results of integrator, the chi-square test was statistically significant, χ^2 (156) = 455.7942, $p <$ 0.05, suggesting a lack of satisfactory model fit (i.e. the hypothesized model was incongruent by researchers because this statistical test is known to be sensitive to the sample size [Bearden, et al. 1982]. We then further assessed the model fit through variety of model indexes, GFI = 0.9241 (>0.9); CFI = 0.9435 (>0.9); NFI=0.9171 (>0.9); RMSEA = 0.0588 (<0.08). Thus, it is concluded that the CFA model fit the data reasonably well based on latter fit indices considered in this study.

Table 1 displays standardized loading above 0.5 and all lambda coefficients for the observed variables are significant (t > 1.96). We eliminated six item of variety seeking, one item of subjective knowledge, three item of domain-specific innovativeness, three items of price sensitivity, six items of information seeking that have standardized loading less than 0.5. The values obtained in composite reliability coefficient are above 0.6. The reliability estimates between 0.6 and 0.7 is acceptable provided that other indicators of a model's construct validity are good to demonstrate the internal consistency of the measurement model (Hair et. al., 2006: 778). The average variance extracts (AVEs) ranged from 29 to 61 percent, which meet minimum requirement (Chin, 1998). Therefore, all the items are retained at this point and adequate evidence of convergent validity is provided.
Discriminant validity among the construct was also assessed by examining whether the square correlation between two constructs was lower than the average variance extracted for each construct (Fornell and Larcker, 1981). Results revealed that these conditions were met, and therefore the constructs investigated in the study were distinct from each other, confirming discriminant validity.

Structural model
After the measurement model was confirmed, structural equation modeling was then performed to test the hypothesized relationships. The model fit statistics revealed a χ^2 of 455.7942 with degree of freedom of 156 at $p <$ 0.05, χ^2 /df of 2.92, GFI of 0.9241; CFI of 0.9435; NFI of 0.9171; RMSEA of 0.0588, suggesting that the hypothesized structural relationships fit the data well. Direct effect of variety seeking on time of adoption and spending behavior is -0.97 percent and 1.71 percent. Subjective knowledge directly explained 5.12 percent of variance in time of adoption and -0.60 percent of variance in spending behavior. Hedonic-idea shopping directly explained -0.73 percent of variance in time of adoption and 4.38 percent of variance in spending behavior. The

effect of general trait of innovativeness on new product adoption behavior can be heightened with the role of domain-specific innovativeness. The total of direct effect and indirect effect of variety seeking on time of adoption and spending behavior is -1.02 percent and 3.44 percent. The total of direct effect and indirect effect of subjective knowledge on time of adoption and spending behavior is 4.94 percent and 6.91 percent. The total of direct effect and indirect effect of hedonic-idea shopping on time of adoption and spending behavior is 0.89 percent and 10.73 percent. We also checked the effect of domain-specific innovativeness on information seeking and price sensitivity. Domain-specific innovativeness explained 39.39 percent of variance in information seeking and 67.47 percent of variance in price sensitivity.

9. Table 1. Measurement model results

Construct	*Indicators*	*λ > 0.5*	*t > 1.96*	*CR*	*AVE (%)*
VS (Variety Seeking)	VS5 (I enjoy exploring several different alternatives or brands when shopping)	0.57	9.2	0.58	41%
	VS6 (To not always buy the same brands, I shop among a few different brands)	0.7	9.99		
SK (Product Knowledge)	SK1 (Compared to my friend and acquaintance, my knowledge of this items)	0.86	23.61	0.87	74%
	SK2 (In general my knowledge of this items)	0.86	22.9		
	SK3 (Would you consider yourself informed or uninformed about this items)	0.86	19.24		
	SK5 (In general, would you consider yourself familiar or unfamiliar with this items)	0.86	13.32		
HE (Hedonic)	HE1 (I go shopping to keep up with the trends)	0.9	25.61	0.87	70%
	HE2 (I go shopping to keep up with the fashion)	0.94	27.19		
	HE3 (I go shopping to see what new products are available)	0.63	16.09		
Domain Specific Innovativeness (DSI)	DSI2 (If I heard that a new consumer electronic product was available in the store, I would be interested enough to buy it)	0.53	-	0.59	32%
	DSI4 (In general, I am the first in my circle of friends to know the brands of the latest consumer electronic product)	0.64	9.43		
	DSI6 (Compared to my friends I own a lot of consumer electronic product)	0.53	8.59		
Price sensitivity	(PS2) I know that a new kind of product is likely to be more expensive than older ones, but does not matter to me.	0.59	-	0.69	42%
	(PS4) I do not mind paying more to try out a new product.	0.73	10.43		
	(PS6) I do not mind spending a lot of money to buy a product.	0.62	10		
Information seeking	(IS2) I often look through catalogues even I am not planning to order anything.	0.55	-	0.62	35%
	(IS5) I often read advertisements just out of curiosity.	0.58	7.67		
	(IS8) Sometimes I amble through stores with curiosity without planning to buy anything.	0.64	7.63		
Time of Adoption (TA)	RTA (Relative time of adoption)	1	0	1	100%
Spending behavior (SB)	RSB (Relative spending behavior)	1	0	1	100%

10. Hypotheses testing

11. Each hypothesized relationship was examined based on path significance. The focus of the assessment of structural path is in the significance of the path can be measured by critical ratios, or statistics, which greater than 1.96 [Chin, 1998] at $p < 0.05$. The result of path coefficients and t-statistics are illustrated in Table 2.

12.

13. Table 2. Hypotheses testing

Path	*Hypothesis*	*Path Weight*	*Critical Ratio*	*Result*
Variety seeking → time of adoption	H1a	-0.01	-0.15	Not Supported
Variety seeking → spending behavior	H1b	0.02	0.27	Not Supported
Subjective knowledge → time of adoption	H2a	0.42	0.81	Not Supported
Subjective knowledge → spending behavior	H2b	-0.01	-0.10	Not Supported
Hedonic-idea shopping → time of adoption	H3a	0.01	-0.13	Not Supported
Hedonic-idea shopping → spending behavior	H3b	0.04	0.80	Not Supported
Variety seeking → DSI → Time of adoption	H4a	0.10→ -0.00	1.43→-0.06	Not Supported
Variety seeking → DSI → Spending behavior	H4a	0.10→0.18	1.43→2.25	Not Supported
Subjective knowledge → DSI → Time of adoption	H5a	0.42→-0.00	6.48→-0.06	Not Supported
Subjective knowledge → DSI → Spending behavior	H5b	0.42→0.18	6.48→2.25	Supported
Hedonic-idea shopping → DSI → Time of adoption	H6a	0.35→ -0.00	1.43→-0.06	Not Supported
Hedonic-idea shopping → DSI → Spending behavior	H6b	0.35→ 0.18	1.43→2.25	Supported
Domain-specific innovativeness → Price sensitivity	H7	0.67	7.65	Not Supported
Domain-specific innovativeness → Information seeking	H8	0.39	5.18	Supported

b. Discussion and conclusion

This study focuses on consumer innovativeness construct, its outcome, i.e. innovation adoption or new product adoption behavior, and the role domain-specific innovativeness as mediator. General trait innovativeness is further disaggregated into variety seeking, subjective knowledge, and hedonic-idea shopping while new product adoption behavior is decomposed into time of adoption and spending behavior. To effectively capture the new product adoption process, a related mediator variable (domain-specific innovativeness) is incorporated in the innovativeness framework as salient determinant of adoption. This study also examines the effect of domain-specific innovativeness on price sensitivity and information seeking. The hypotheses pertaining to the impact directly of general trait innovativeness on new product adoption behavior does not support. The result reveals that variety seeking, subjective knowledge, and hedonic-idea shopping do not directly effect on time of adoption and spending behavior. Our results thus are consistent with Goldsmith et al. (1995) and Im et al. (2003); generalized consumer innovativeness does not directly influence adoption behavior in a specific product category. In addition, a stronger support for the hierarchical model (with domain specific innovativeness as a mediator between general trait innovativeness and new product adoption behavior) suggests that the hierarchical innovativeness trait approach (general trait innovativeness - domain-specific innovativeness trait - innovative behavior) increases the innovativeness trait's ability to explain new product adoption behavior.

Our result reports that domain-specific innovativeness successfully become mediator between subjective knowledge and spending behavior and also between hedonic-idea shopping and spending behavior. Nevertheless, domain-specific innovativeness does not successfully become mediator between subjective knowledge and time of adoption; between hedonic-idea shopping and time of adoption. In addition, domain-specific innovativeness does not mediate the relationship between variety seeking and new product adoption behavior (time of adoption and spending behavior). This can happen because innovators may change mobile phone models if there is a new product emerged. Thus they adopt a shorter time than non-innovators**.** They spend more money in buying mobile phone compared to non-innovators. This finding is inconsistent with Rijsoever and Donders (2009). Although the use of time of adoption also permits the products that are not innovative at the present to be still included in the measure, thus providing an image of actualized innovativeness throughout a longer period of time. This measure is thus very susceptible to the influence of age or other time-related variables. Our result is consistent with Hirunyawipada and Paswan (2006) that domain-specific innovativeness positively related with acquire information associating with new products. The result shows that the effect of domain-specific innovativeness on price sensitivity has been somewhat inconsistent with Goldsmith (1996). We find it interesting that domain-specific innovativeness has positive impact on price sensitivity. It may innovators who adopting mobile phone are persons who are sensitive with the price, but they spend more money to buy mobile phone.

c. Managerial Implications

The findings of this study provide several managerial contributions for the adoption of mobile phone. Consumers are influenced by different elements of innovativeness. The finding of this study suggests that subjective knowledge, hedonic-idea shopping, and domain-specific innovativeness make up the best potential combination of determinants to innovation adoption. This finding has interesting implication for segmentation decisions. Focusing on how to increase consumers' subjective knowledge could help increase opportunities for consumers to adopt more new products. Hedonic-idea shopping motivation is related with the satisfaction of person's desires. When hedonistic values are preferred by individuals, they will positively influence the acceptance of new products whose consumption gives excitement and pleasure to the adopter. Consumers who are innovators are significantly likely to actively seek more information. These findings support a well established of marketing research suggesting that those who have high level of subjective knowledge and hedonic-idea shopping about a particular domain are likely to be early adopters and spend more money. This study provides evidence that the higher level of domain-specific innovativeness, the more consumers actively seeking information. The result also gives contribution to managers that innovators in mobile phone are persons who are sensitive in price but they spend more money. The more marketers know about early adopters, the better able they will be to reach and communicate with them with the intention of informing and persuading them to buy new products through skillfully designed marketing strategies.

d. Limitation and further research

The limitations of this study reveal the opportunities for expanding the new product adoption and consumer innovativeness knowledge. The generalizability of the results may be limited because the current study uses a student sample. Future research needs to be replicated this model with non-student sample. The study is conducted in a single product– mobile phone. We suggest that future research use measurement of innovations characteristics in the technology acceptance model (TAM; Davis, 1989) to relate between domain-specific innovativeness and new electronic products adoption (*general trait innovativeness-domain specific innovativeness-innovation characteristics-new product adoption behavior*) to expand the external validity of the findings. Therefore, future research should be conducted to pinpoint the reason for this issue and seek a correction.

References

Argawal, R., and Prasad, J. (1998). A conceptual and Operational Definition of Personal Innovativeness in the Domain of Information Technologies. Decision Sciences, 28(3), 557-694.

Arnold, M.J. and Reynolds, K.E. (2003). Hedonic shopping motivations. Journal of Retailing, Vol. 79, pp.77-95.

Brucks, M. (1985). The effects of product knowledge on information search behavior. Journal of Concumer Research. 12(June), 1-16.

Citrin, A.V., Sprott, D.E., Silverman, S.N., and Stem, D.E. (2000). Adoption of internet shopping: the role of consumer innovativeness. Industrial management and data systems, vol. 100 no 7, pp.294-300.

Davis, F.D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. MIS Quartely, 13(3), 319-339.

Foxall, Gordon R. (1988). Consumer innovativeness: novelty-seeking, creativity, and cognitive style. Research in Consumer Behavior, vol. 3, pp. 79-113.

Gatignon, H. and Robertson, T. S. (1985). A propositional inventory for new diffusion research, Journal of Consumer Research, 11 (March), 849-867.

Goldsmith, R.E. and Hofacker, C.F. (1991). Measuring consumer innovativeness. Journal of the Academy of Marketing Science, vol. 19 no. 3, pp. 209-21.

Goldsmith, R.E., Freiden, J.B., and Eastman, J.K. (1995). The Generality/Specifity Issue in L.V. Shavinina (Ed.). The International Handbook on Innovation (pp. 321-330). Kidlington, Oxford, UK: Elsevier.

Goldsmith and Elizabeth B. Goldsmith (1996). An Empirical Study of Overlap of Innovativeness. *Psychological Reports*, vol. 79, pp. 1113-1114.

Goldsmith, Ronald E., Newell, Stephen J. (1997). Innovativeness and price sensitivity: managerial, theoretical and methodological issues. *The Journal of Product and Brand Management*, vol. 6, pp. 163.

Hair. et al. (2006). Multivariate Data Analysis. Sixth Edition.USA:Prentice Hall International, Inc.

Han, S., Gupta, S., & Lehmann, D. (2001). Consumer price sensitivity and price thresholds. *Journal of Retailing*, 77(4), 435-456.

Hirunyawipada , Tanawat and Audhesh K. Paswan (2006). Consumer innovativeness and perceived risk: implications for high technology product adoption. Journal of Consumer Marketing. Vol. 23 No 4, pp. 182-198.

Im, S., Mason, C.H., and Houston, M.B. (2007). Does Innate Consumer Innovativeness Relate to New Product/ Service Adoption Behavior? The Intervening Role of Social Learning Via Vicarious Innovativeness. Journal of the Academy of Marketing Science, Vol. 35, pp. 63-75.

Kirton, M. (1976). Adoptors and Innovators: a Description and Measure. Journal of Applied Psychology, Vol.61 No.5, pp. 622-9.

McAlister, L., and Pessemier, E., (1982). Variety-seeking behavior: an interdisciplinary review. Journal of Consumer Research, 9(3), 311-322, doi:10.1086/208926, http://dx.doi.org/10.1086/208926.

Meuter, Matthew L., Mary Jo Bitner, Amy L. Ostrom, and Stephen W. Brown (2005). Choosing Among Alternative

Midgley, D.F., and Dowling, G.R. (1978). Innovativeness-concept and its measurement. Journal of Consumer Research, 4(4), 229-242.

Mobile Nation, 2011. [online]. [Accessed, 20th May 2012]. Available from JakartaGlobe Web: http://www.thejakartaglobe.com/specialfeatures/mobile-nation/467998

Mobile Phone Penetration in Indonesia Triples in Five Years. 2011. [online]. [Accessed, 20th May 2012]. Available from Nielsenwire Web: http://blog.nielsen.com/nielsenwire/global/mobile-phone-penetration-in-indonesia-triples-in-five-years/

Nasution, R.A. and Astuti, N.C (2012). Consumer Innovativeness Model of Indonesian Young Consumers in Electronic Products Adoption. In the Proceedings of 18th ICE Conference, Munich.

Oliver, R.L. and Bearden, W.O. (1983). The role of involvement in satisfaction processes. in Bagozzi, R.P. and Tybout, A.M.(Eds), Advances in Consumer Research, Association for Consumer Research, Ann Arbor, MI, pp. 250-55.

Park, W.C. and Lessig, V.P. (1981). Familiarity and its impact on consumer decision: biases and heuristics. Journal of Consumer Research, 8(September), 223-230.

Park, W.C., Mothersbaugh, D.I., and Feick, L. (1994). Consumer knowledge assessment. Journal of Consumer Research, 21(1), 71-82.

Raju, P.S. (1980). Optimum stimulation level: its relationship to personality, demographics and exploratory behaviour. Journal of Consumer Research, Vol.7, pp. 272-282.

Rijnsoever, Frank J., A. Rogier T. Donders (2009). The Effect of Innovativeness on Different Levels of Technology Adoption. *Journal of the American Society for Information Science and Technology*, 60(5), 984–996.

Rogers, E.M.(2003). Diffussion of Innovations.New York: The Free Press.

Van Tripj, H., Hoyer, W., & Inman, J. (1996). Why switch? Product category-level explanations for true variety-seeking behavior. Journal of Marketing Research (JMR), 33(3), 281-292.

BANDUNG AS SERVICE CITY IN INDONESIA: ROLE OF ACADEMICIAN, BUSINESS, AND COMMUNITY

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Abstract
Bandung, the capital city of West Java, province in Indonesia, the country's third largest city, has the vision to be a service city that cleans, prosperous, obedient and friendly. Using the triple helix framework built by Etzkowitz and Leydesdoff , this research aims to elaborate the role of academician, business, and government in Bandung to support the local government to reach its vision as service city in Indonesia. The paper investigated the nature, relative scale, and contribution of each party in accordance with vision, mission and strategic goals of Bandung. It also explored the capabilities required by the society to derive value from the collaboration of each party. Analysis of all data both primary and secondary will result in a form of conceptual model and will be discussed in this study. The empirical result will become a useful model foundation for the government of Bandung, also for the central government of Indonesia.

Keywords: service city, triple helix, quadro helix, Bandung-Indonesia

F. Triple Helix Model for Innovation and Commercialization

TRIPLE-HELIX RELATIONS AND POTENTIAL SYNERGIES AMONG TECHNOLOGIES, INDUSTRIES, AND REGIONS IN NORWAYA

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Abstract
Using information theory and data for all (0.5 million) Norwegian firms, the national and regional innovation systems are decomposed into three subdynamics: (i) economic wealth generation, (ii) technological novelty production, and (iii) government interventions and administrative control. The mutual information in three dimensions can then be used as an indicator of potential synergy, that is, reduction of uncertainty. We aggregate the data at the NUTS3 level for 19 counties, the NUTS2 level for seven regions, and the single NUTS1 level for the nation. Measured as in-between group reduction of uncertainty, 11.7 % of the synergy was found at the regional level, whereas only another 2.7% was added by aggregation at the national level. Using this triple-helix indicator, the counties along the west coast are indicated as more knowledge-based than the metropolitan area of Oslo or the geographical environment of the Technical University in Trondheim. Foreign direct investment seems to have larger knowledge spill-overs in Norway (oil, gas, offshore, chemistry, and marine) than the institutional knowledge infrastructure in established universities. The northern part of the country, which receives large government subsidies, shows a deviant pattern.

Keywords: synergy; R&D funding; Norway; mutual information

COLLABORATION AND THE GENERATION OF NEW KNOWLEDGE IN NETWORKED INNOVATION SYSTEMS: A BIBLIOMETRIC ANALYSIS

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Abstract
Canola, a high-value, export-oriented agricultural commodity, was developed in Canada over the course of 40 years in public institutions, driven by imported technology and imported research scientists. The evolution of canola R&D closely mirrors the evolution of the Triple Helix Models of innovation. Through the application of longitudinal citation analysis, using five-year intervals, publications from Canadian public institutions involved in canola R&D have been analyzed. In the most recent five-year interval, the relative citation rates of public sector research increased by 60% compared to the global average. A unique fixed-effect negative binomial regression model is used to demonstrate the critical relationship between the institutional arrangement that governs collaboration and the production of knowledge that underscores technological innovation.

Keywords: canola; public-private partnerships; triple helix; regression analysis; citation analysis; agricultural R&D

HIERARCHIC MODEL OF CREATING POLICY FOR DEVELOPING INNOVATIVE TECHNOLOGIES SUPPORTING SUSTAINABLE ECONOMIC GROWTH

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Introduction

Innovativeness and competitiveness of the economy are determined by an effective realisation of R&D strategies both at a macroeconomic, national level and a microeconomic, that is research institution's level. The development strategies are to a great extent shaped by the economic situation and global technological development trends. The science, industry and the government are involved in this process at the strategic level (macro), whereas R&D institutions responsible for the development and implementation of advanced technologies in priority research directions play an important role as far as the operational (micro) level is concerned. What plays a crucial role at the time of forming and realising the development strategies are the identification of future research directions and the generation of short- and long-term trends in the development of advanced technologies, which is conducted within foresight projects at different levels – national, sectoral and corporate ones. The determination 2 of research directions of the future is of key importance from the perspective of research institutions as it supports the design of a short-, medium-, as well as long-term thematic scope and strategy of their R&D activities. Practical application of foresight project results enables conducting research in domains, in which a particular institution has appropriate substantial, infrastructure and financial potential.

The authors of the paper have participated in foresight projects at different levels, among others in the National Foresight Programme "Poland 2020"1, sectoral foresight "Advanced Industrial and Ecological Technologies for the Sustainable Development of Poland"2 as well as corporate foresight3. Experience obtained in the course of execution of foresight projects as well as results of analyses of foresight projects realised in Poland and other countries indicated that there is a lack of interrelation of foresight executed at higher level, e.g. national with those executed at lower levels (regional, sectoral, corporate). New foresight projects financed from European structural funds are frequently undertaken in a chaotic way, in many cases without consideration of the results of other foresights. To achieve valuable results from the execution of hierarchic foresight projects it is of crucial importance to ensure the hierarchic interrelations between priority research areas generated within national foresight projects and sectoral foresights (identification of the research areas of the future and visions for their development) as well as corporate foresights (indication of key technologies to be developed at a research organisation or in an enterprise). However, there is a lack of a consistent methodology of hierarchic mechanisms for the application of foresight results. Foresight projects are generally aimed at the generation of priority research directions and in many cases recommending incremental or breakthrough (emerging) technologies (Fig. 1). Incremental technologies are mainly realised at existing individual research organisations, whereas the development of breakthrough research areas requires the introduction of appropriate mechanisms and structures (e.g. national research institutes) enabling the development of priority research directions and technologies.

1 The authors of the paper fulfilled the roles of the Head (Adam Mazurkiewicz) and the Scientific Secretary (Beata Poteralska) of the Main Research Area Panel "Sustainable Development of Poland", respectively
2 The authors of the paper fulfilled the roles of the Co-ordinator (Adam Mazurkiewicz) and the Scientific Secretary (Beata Poteralska) in the project
3 Carried out at the Institute for Sustainable Technologies – National Research Institute, managed by the authors of the paper.

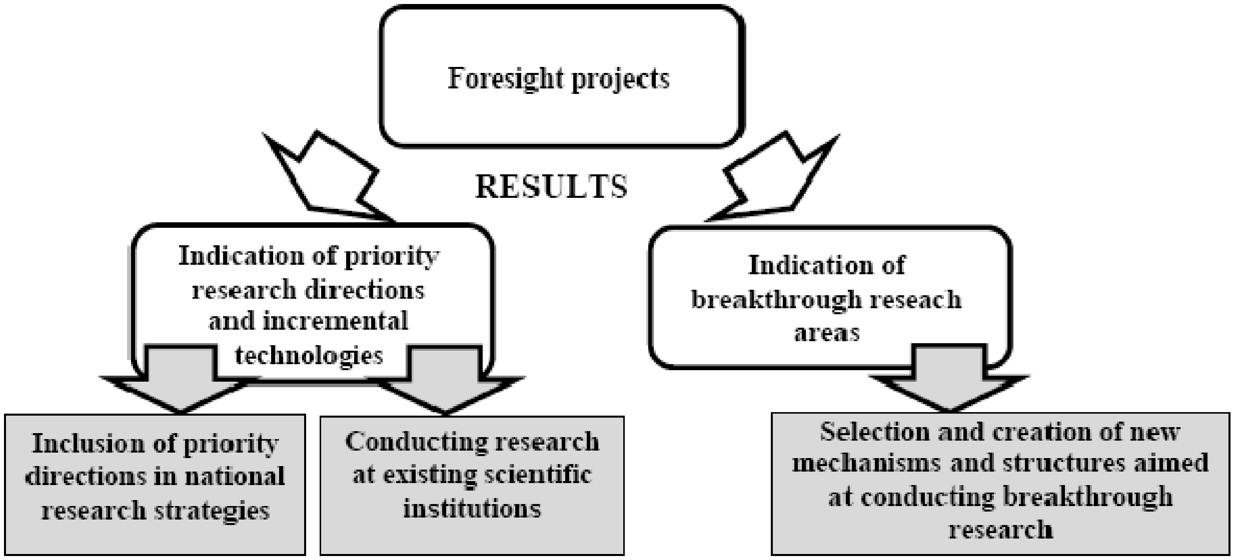


Fig. 1. Types of results consisting in the generation of research priorities, obtained as an outcome of foresight projects.
Source: Authors

Foresight project results are applied in the course of launching research programmes in domains of the highest priority, and strategic programmes seem to be the most appropriate formula. Strategic programmes may be launched, on the one hand, by scientific organisations conducting research in a particular domain, and on the other hand, at the macro (national) level by specialised governmental organisations, such as in case of Poland – National Centre for Research and Development, which are able to effectively select and launch, at the national level, the mechanisms and structures needed.

State-of-the-art

Foresight applied for the creation of a medium and a long term visions of the economic and social development, has been in use for a few decades already.4 Foresight facilitates and supports the processes of decision making in the area of future sustainable development. It has won general acclaim and has been used on a large scale in a number of countries and at different organisational levels, i.e.: national, sectoral, regional, and corporate.

Nowadays, there are weak linkages observed between national foresight projects and the foresight projects realised at the sectoral and corporate levels.5 On the other hand, the range of practical applications of the results of foresight projects concerning, for instance, the determination of priority research directions to be financed at the national level, or the introduction of new types of programmes or institutions stimulating the development of the domains of strategic character, remains insufficient.

The implementation of the results of foresight projects is a complex hierarchic process difficult to be conducted. Effectiveness of implementing foresight project results is often possible to be evaluated only from a distant time perspective. Nevertheless, some foresight projects have ended with practical application of their results, i.e., the recommendations were used in launching new research programmes at the national or regional level6,7 or specialised

4 Jemala M., Evolution of foresight in the global historical context, foresight, Vol. 12, 2010, Iss: 4, pp.65 - 81
5 Poteralska B. Hierarchic Structure for Generation of Innovative Research Directions and Technologies, XXIII ISPIM Conference – Action for Innovation: Innovating from Experience, Barcelona, Spain, 2012.
6 Keenan M., Marvin S., Winters C., Mobilising the regional foresight potential for enlarged European Union, United Kingdom Country Report, Brussles, 2002

projects for the support of research directions of the future. Additionally, results of foresights were applied to introduce changes in existing R&D financing mechanisms.8,9,10,11

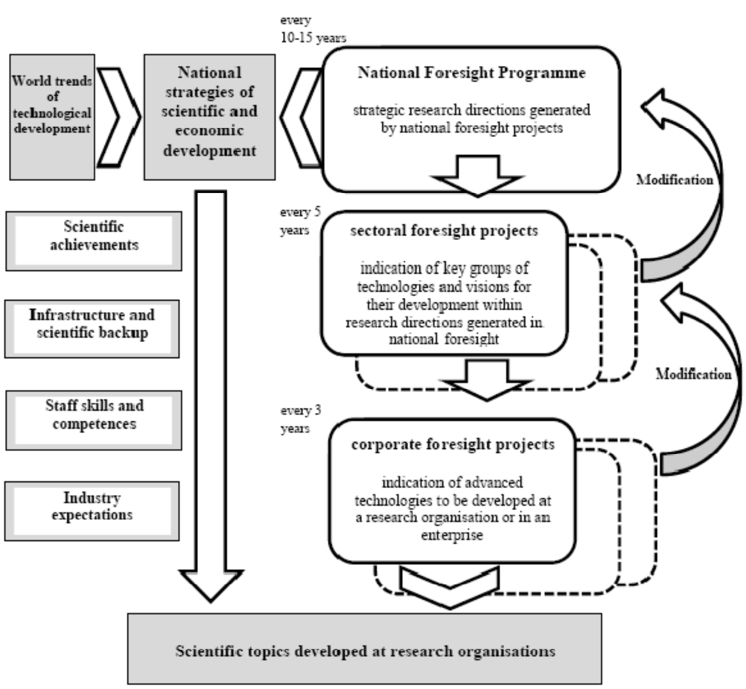
Foresight projects are realised at different levels, somewhat independent of one another, without any crucial application of the results of projects at lower levels. It concerns among others the relation between the national foresight project and sectoral foresights and next sectoral foresights and corporate ones.

Although they are not numerous, examples of practical application of foresight project results and implementation of the hierarchic approach to the generation of new scientific directions and future technologies are known. However, the hierarchic structure of applying project results is not popularly used yet or knowledge on that issue is not sufficiently disseminated.

The knowledge on the aspects of practical implementation of foresight project results is still fragmentary, not widely disseminated, not well indicated in the literature and examples of such implementation activities are rare.

Methodology

The authors proposed the model for the formulation of innovation policy in the field of technical support for sustainable development comprising a system approach to the generation of research directions based on foresight project results and operational activities. The developed model assumes that the priority directions will be determined by national economic and scientific development strategies incorporating the results of foresight (eg. national or sectoral foresight programmes). Priority research topics selected at the macro level within the national foresight that is typically undertaken every 10-15 years, and sectoral foresight conducted every 5 years are directed at the determination of key technologies and the visions for their development. The directions strategic for the country are verified and detailed within sectoral foresight projects and implemented in corporate foresight realised cyclically, not rarer than every 3 years and aiming at the generation of innovative technologies conditioning the functioning of the R&D institutions or the enterprises. Research directions conducted at research organisations are determined, on the one hand, by the results of foresight projects at different levels and, on the other hand by national strategies of scientific and economic development (Fig. 2).



7 Klusacek K., Technology Foresight in the Czech Republic, Discussion Paper Series, article 03-15, 2003
8 Giesecke S., Futur – The German Research Dialogue, Foresight Brief No.1, The European Foresight Monitoring Network EFMN, 2007
9 National and Regional Key Technologies, European Foresight Monitoring Network, www.efmn.info, 2008
10 Cadiou Y., From key-technologies to key-competencies. Scientific and technological competencies at the regional level related to the French "Key-Technologies" exercises, The Second International Conference on Technology Foresight, Tokyo, 2003
11 Hoffmann B., Rader M., WP 1 - Review and analysis of national foresight. D1.1FR - Case study France - technologies clés 2005, Report on the realisation of the FISTERA Project in 5PR, 2003

Indicated priority research directions, and incremental and emerging technologies within them are detailed topics that should be incorporated into research projects realised.
Priority research directions are developed within different research programmes out of which the strategic programmes seem to be the most effective. Their subject areas are generated with the consideration of the priorities included in strategic European and national documents, strategic programmes and projects previously conducted by R&D institutions, as well as the results of foresight projects at different levels. In practice, these are the strategic programmes that enable the realisation of tasks in directions considered to be of the greatest importance for the development of the economy.
Joint consideration of the results of different kinds of foresight projects (national, sectoral, corporate) and the directions of research conducted at a research institution, including those carried out within national research programmes enables the identification of the thematic areas of strategic research programmes (Fig. 3).

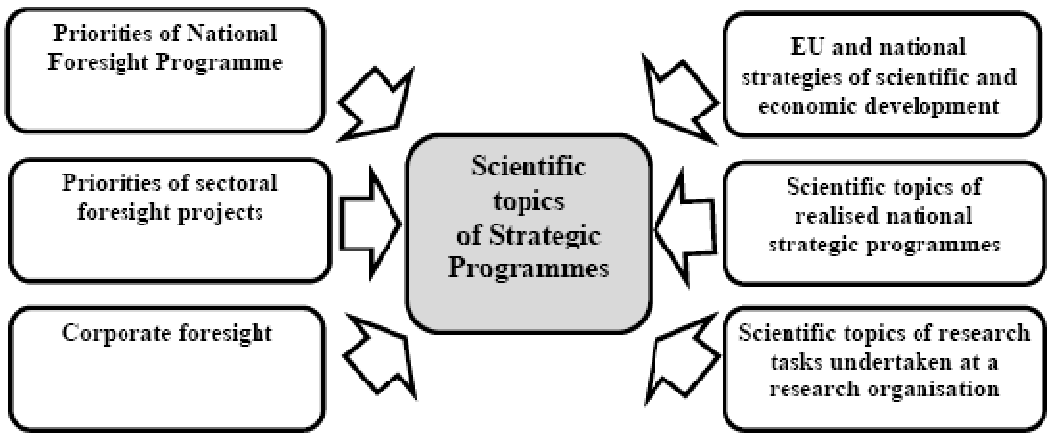


Fig. 3. Generation of scientific topics covered by a strategic research programmes
Source: Authors
There can be observed the feedback concerning the determination of priority R&D directions included in national strategic documents and generated within foresight projects at different levels (national, sectoral, corporate). It results from the fact that individual R&D institutions undertake research in the areas strategic for the country (top-down approach) and on the other hand advanced technologies dynamically developed by these institutions influence the strategic scientific areas of the country (bottom-up approach).
Findings and interpretation
The presented model has been applied in practice. The National Foresight Poland 202012 realised with significant factual and managerial input of the authors of the article, assumed the general characterisation of technologies of key importance to the national economic growth. The technologies indicated within the National Programme were then detailed within the sectoral foresight managed by the authors of the article concerning the technical support for sustainable development of the economy,13,14 within which research directions of the future were first identified for mechatronic, materials and nanotechnologies, technical and environmental safety, and green technologies, as well as for test and research apparatus, and then priority incremental and breakthrough technologies in these fields were generated and characterised. The draft of how research directions of the future are generated within the sectoral foresight is presented in Fig. 4.

12 Kleer J., Wierzbicki A. (ed.) National Foresight Programme Poland 2020. Polish Academy of Sciences. 2009, ISBN 978-83-61236-09-2, pp. 105-152
13 Mazurkiewicz A., Poteralska B. Determining the priority research directions and key advanced technologies using foresight methods. In: Huizingh K. R. E., Conn S., Torkkeli M., Bitran I. (Eds.) Proceedings of The XXI ISPIM Conference, Bilbao, Spain 6-9.05.2010, ISSN 9789522149268
14 Results of sectoral foresight "Advanced Industrial and Ecological Technologies for the Sustainable Development of Poland" are available at the project website www.portaltechnologii.pl

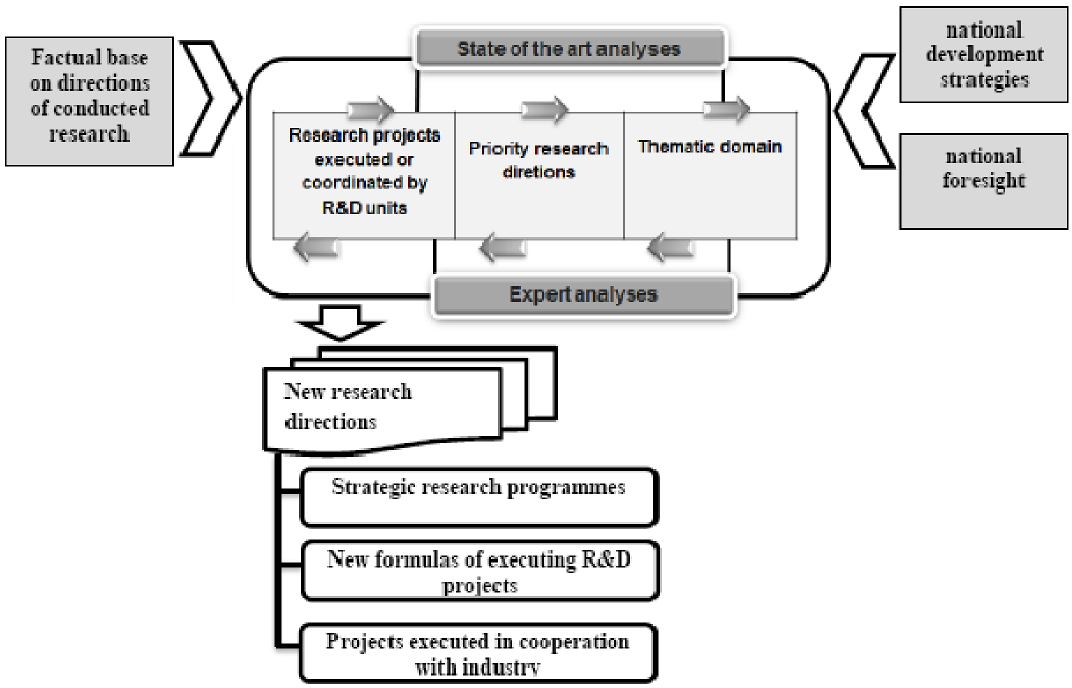


Fig. 4. Methodology of generating research directions crucial for the development of advanced industrial technologies

Source: Authors

Next, the corporate foresight was conducted by the technological institute – Institute for Sustainable Technologies – National Research Institute (ITeE-PIB) ranking highest in Poland as far as the aforementioned research areas are concerned. The corporate foresight allowed for the identification of priority technologies and their research tasks, which were both closely correlated with the strategic R&D directions generated in the national and sectoral foresight projects and took the research, infrastructure, and financial potential of the organisation into consideration (Fig. 5).

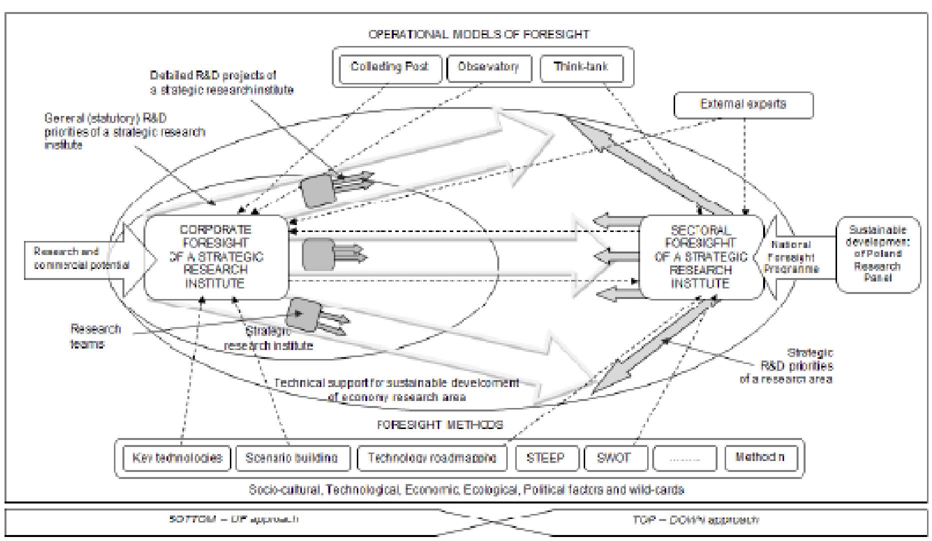


Fig. 5. Methodology of corporate foresight executed at the Institute for Sustainable Technologies – National Research Institute

Fig. 5. Methodology of corporate foresight executed at the Institute for Sustainable Technologies – National Research Institute

Source: Doctoral thesis by Anna Sacio-Szymańska "Metoda foresight technologicznego narzędziem wyznaczania kierunków rozwoju strategicznych instytutów badawczych", Cracow University of Economics, 2010, supervised by Prof. Adam Mazurkiewicz

The hierarchic structure for the realisation of foresight projects and a hierarchic structure of results obtained is presented in Fig. 6., whereas practical application of the model designed is shown in Table 1 on the example of sectoral foresight with regard to one selected domain – environmental technologies.

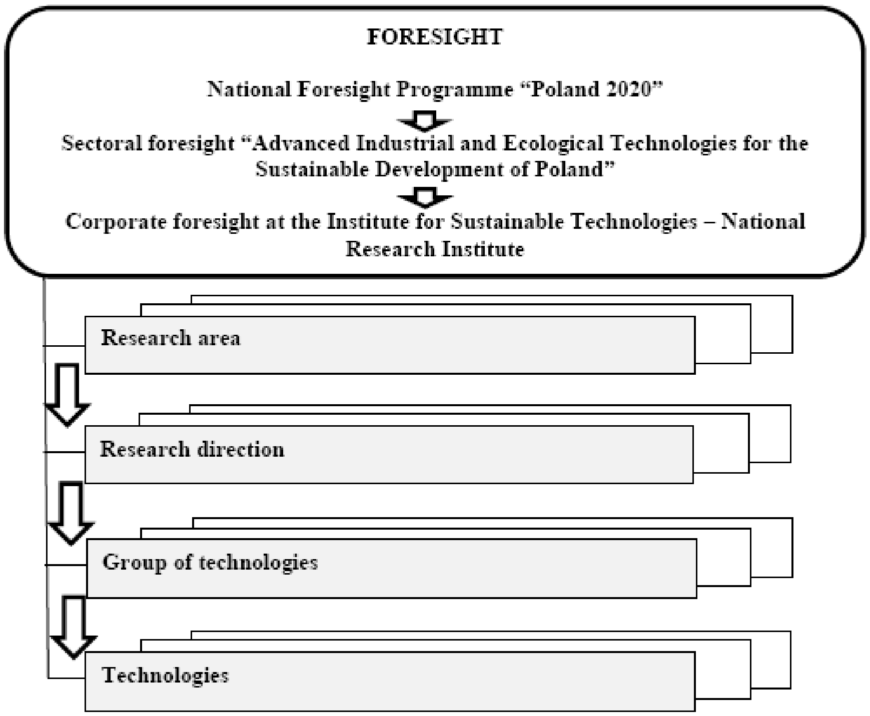


Fig. 6. Hierarchic structure for the realisation of foresight projects and a hierarchic structure of results obtained.
Source: Authors

Table 1. Practical application of the model of hierarchic structure for the realisation of foresight projects on the example of the sectoral foresight "Advanced Industrial and Ecological Technologies for the Sustainable Development of Poland".

RESEARCH AREA	RESEARCH DIRECTION	GROUP OF TECHNOLOGIES	TECHNOLOGIES
Environmental technologies	Production technologies for maintenance materials with higher ecological value	Production technologies for biodegradable operating fluids and plastic lubricants	Production technologies for special lubricating materials
			Production technologies for special, ecological operating fluids based on natural and synthetic components
		Technologies of production of biocomponents of operating fluids	Production technologies for special, ecological operating fluids based on natural and synthetic components
			Production technologies for special lubricating materials
		New generation of lubricating materials with nanoparticles	...
		Technologies of production of contemporary biopolymer materials, polymers and composites with higher biodegradability	...
	Technologies for the rationalisation of the use of resources	...	...

Source: Authors

The designed hierarchic model was applied for the creation of the thematic scope of the strategic research programme undertaken at the technological Institute for Sustainable Technologies – National Research Institute (ITeE-PIB) in Radom, Poland. The application of the presented approach resulted in the generation of the thematic scope of the currently realised "Innovative Systems of Technical Support for Sustainable Development of Economy" Strategic Programme, within which technological solutions facilitating sustainable economic growth are developed.

With the use of the approach presented the thematic scope of a new Strategic Programme was generated (Fig. 7).

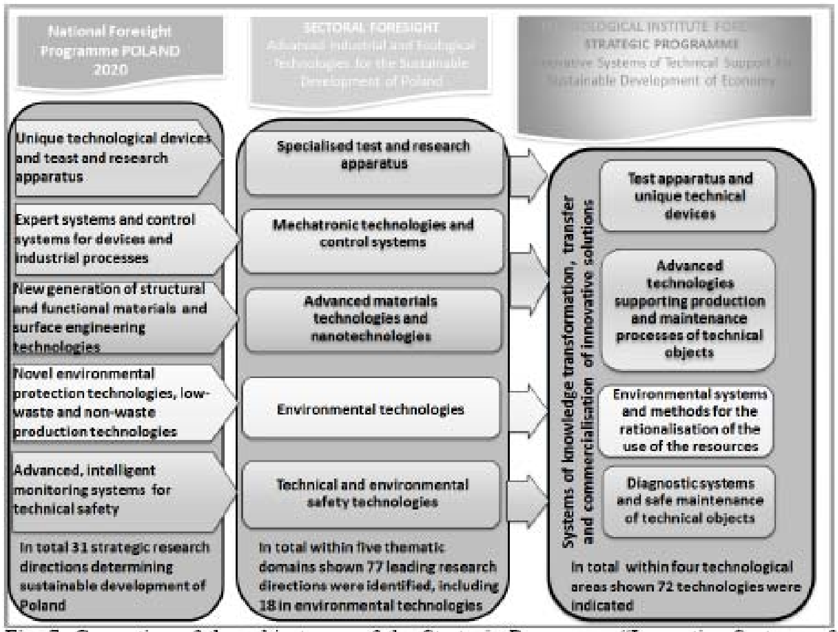


Fig. 7. Generation of the subject area of the Strategic Programme "Innovative Systems of Technical Support for Sustainable Development of Economy"
Source: Authors

The subject matter of the Strategic Programme has been determined, on the one hand, by the priorities indicated in EU and national strategic documents, thematic areas of governmental programmes of strategic importance, priorities of National Foresight Programme "Poland 2020", and on the other hand by the results of the sectoral foresight project "Advanced Industrial and Ecological Technologies for the Sustainable Development of Poland" 15,16 and the results of the corporate foresight project, conducted by the authors of the article.17

Strategic Programme was submitted within the Innovative Economy Operational Programme co-financed from EU structural funds. It was assessed by an international team of experts, won over other prominent competitors, and was approved for realisation in the 2010 – 2014 period. The fact that the strategic programme was granted the funds for its realisation strongly confirms that the proposed research directions are of priority to the development of economy and that the perspective character of research tasks within indicated directions will positively influence competitiveness and innovativeness of the economy and first of all efficiency of modelling hierarchic foresights.

The Programme is aimed at the development of both advanced product and process solutions ready for practical industrial implementation in the area of manufacturing and maintenance of technical objects and system solutions supporting their application.

The R&D matters revolve around five main thematic areas concerning:

- advanced technologies facilitating manufacturing and maintenance processes;
- environmental systems and methods for the rationalisation of the use of resources
- systems for safe maintenance of technical objects;
- test apparatus and unique technological devices;
- knowledge transformation and technology transfer systems enabling technical and operational support for undertaken technological tasks and a successful application and commercialisation of achieved research results.

15 Mazurkiewicz A. (ed.) Techniczne wspomaganie zrównoważonego rozwoju. Kierunki badawcze i aplikacyjne. Instytut Technologii Eksploatacji – PIB, Radom 2011

16 Mazurkiewicz A., Poteralska B. (eds.) Zaawansowane technologie przemysłowe i ekologiczne dla zrównoważonego rozwoju kraju. Wybrane zagadnienia. ITeE-PIB Radom 2011

17 Sacio-Szymanska A., Mazurkiewicz A., Poteralska B.: Setting priority R&D directions for the strategic research institutes. In: Huisingh K. R. E, Conn S., Torkkeli M., Bitran I (eds.) XXII ISPIM Conference. Sustainability in Innovation: Innovation Management Challenges, ISBN 978-952-265-091-7, Hamburg 2011.

In the Strategic Programme launched technological areas are of key importance, as innovative technological solutions in the field of technical support for sustainable development are designed and manufactured within these areas. An effective realisation of strategic programmes requires close interactions and connections between the research tasks covered by technological areas mentioned and activities for the system support in the area of knowledge transformation and technology transfer as well as activities for the organisational support in the form of technological and informational platforms aiming first at the development and then the dissemination of innovative solutions (Fig. 8).
Within the Strategic Programme the package of activities and procedures aimed at improving the efficiency of knowledge transformation and technology transfer processes was proposed, embracing the interrelated issues of:

- current modification of executed research directions and cyclic generation determination of future directions (corporate foresight);
- comprehensive evaluation of executed research tasks and the strategic research programme as a whole;
- implementation maturity and commercial potential assessment of technological solutions;
- search for effective mechanisms and structures for innovation deployment;
- creation of organisational and informational platforms facilitating cooperation and dissemination of innovative solutions;
- education of personnel developing and using advanced technologies;

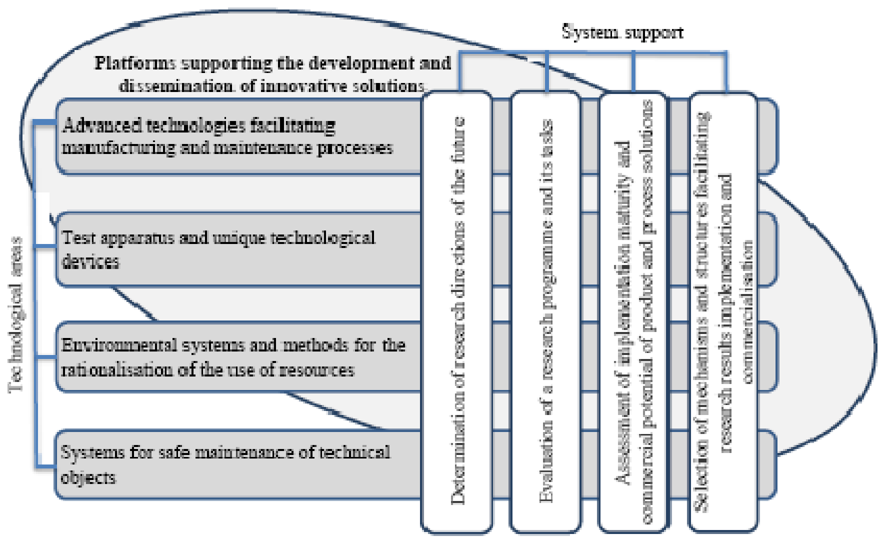


Fig. 8. Correlation of the realisation of research tasks of technological nature with activities providing system support in the area of knowledge transformation and technology transfer and organisational support
Source: Authors

System tasks undertaken within the Strategic Programme aim at the procurement of innovative solutions complying with global standards, focus on the practical application of research results and the creation of the cooperation network between the R&D and industry sectors, which is enhanced by the development of organisational and IT platforms. Realisation of tasks in the area of knowledge transformation and technology transfer contributes to effective dissemination, commercialisation and implementation of technological and organisational results of the Programme.
Simultaneously, the realisation of R&D tasks directed at the development of innovative technological solutions, enables the determination of priority areas and detailed research directions and advanced technologies within them that should be further developed, supported at the national and the sectoral levels, incorporated into national strategic documents, and considered in a foresight. Generated future research directions and technologies are also taken into consideration at the time of the selection of thematic areas of strategic and R&D projects and the initiation of cooperation between research institutions and enterprises in the field of the development and implementation of technologies of the future.

Conclusions

Nationally undertaken system activity for the support of research development and the practical application of research results are manifested in the consideration of foresight results at the time of the generation of strategic R&D directions to be realised, *inter alia*, within the formula of strategic research programmes. Effective application of results of foresight projects at national, sectoral and corporate levels requires the correlation of their subject.

Policy implications and directions for further research

The article presents the outline of the model for the formulation of innovation policy in the field of technical support for sustainable development comprising system approach to the generation of research directions based on hierarchic foresight project results. The model and an example of its practical application are presented. It is important to ensure greater interrelation of foresight projects at different hierarchic levels. The model presented assumes the interrelation of a national, sectoral and corporate foresight. It would be advisable to widen the scope of the analysis and also include the aspect of the relation between European-level foresight projects and national foresight projects, as well as relations between sectoral and corporate foresight projects. It is important to track the way from the generation of priority research directions at a macro level (European, national) to specific technological solutions developed at a micro level (research organisation, enterprise) and to assess these solutions in terms of their practical application possibilities. Furthermore, the exploration of the possibilities and the effects of practical application of foresight project results is of crucial importance as well, namely the evaluation of foresight projects effectiveness, analysed both in the hierarchic structure and independently at each level. Currently, although foresight is well known and used across the world, its efficiency and effectiveness of its application is not yet at a credible level and there is a lack of assessment and validation of its effectiveness in a medium or long time perspective. There is a need to develop the methodology of hierarchical approach to applying foresight project results and their complex assessment.

The following aspects of evaluating the practical implications of foresight projects could be taken into account:

- analysis of possible applications of results of foresight projects: e.g. identification of priority research directions from a list of those generated within foresight projects, to be financed at a national level, generation of new types of strategic programmes or establishment of institutions at the national level aiming at the development of research domains considered to be of priority from a strategic point of view.
- analysis of potential economic results of foresight projects that are visible in the development and implementation of new technologies within research directions identified as priority.
- analysis of the effectiveness of national foresight projects in terms of the accuracy of predictive foresight projects (forecasting) taking into account that foresight is different from forecasting as it is supposed to create the future rather than forecast it, it is even more important to check the accuracy of foresight.

The evaluation issue is connected with the need of cyclic undertaking of foresight projects, which is obviously interrelated with the outcomes of the evaluation of foresight project results and existence of a reliable foresight evaluation methodology.

These issues are considered in the currently undertaken activities aimed at launching a new Action within European Commission COST Programme. The Action, proposed by the authors of the article and the Institute for Sustainable Technologies – National Research Institute as a leading organisation with participation of institutions from nine countries (Poland, Austria, Czech Republic, Denmark, Israel, Italy, The Netherlands, Slovakia, Spain), entitled "Application of foresight project results. Analysis of strategic and operational conditions" is aimed at exploring the possibilities and the effects of practical application of foresight project results. The importance of the topics embraced by the Action results from the fact that the knowledge on practical implementation of foresight project results is fragmentary and often does not exist at all. Thus, it is crucial to enhance co-operation among institutions experienced in this field to share knowledge, learn from relevant case studies, and to propose methodological solutions that have a chance to be successful. The importance of the topic also results from the fact that foresight exercises are more and more popular and widely executed, thus the importance of practical implementation of their results increases and is much more expected by its users (i.e. policy-makers, managers). The topic is interesting for many scientific circles including institutions financing foresight projects and executors of such projects, for whom practical value of foresight and the implementation of its results are crucial. The importance and interest in the topic is confirmed by the fact that all organisations, with great knowledge of and experience in foresight undertakings, invited to join the initiative agreed to do so.

References

1. Cadiou Y., From key-technologies to key-competencies. Scientific and technological competencies at the regional level related to the French “Key-Technologies” exercises, The Second International Conference on Technology Foresight, Tokyo, 2003

2. Giesecke S., Futur – The German Research Dialogue, Foresight Brief No.1, The European Foresight Monitoring Network EFMN, 2007

3. Hoffmann B., Rader M., WP 1 - Review and analysis of national foresight. D1.1FR - Case study France - technologies clés 2005, Report on the realisation of the FISTERA Project in 5PR, 2003

4. Jemala M., Evolution of foresight in the global historical context, foresight, Vol. 12, 2010, Iss: 4, pp.65 - 81

5. Keenan M., Marvin S., Winters C., Mobilising the regional foresight potential for enlarged European Union, United Kingdom Country Report, Brussles, 2002

6. Kleer J., Wierzbicki A. (ed.) National Foresight Programme Poland 2020. Polish Academy of Sciences. 2009, ISBN 978-83-61236-09-2, pp. 105-152

7. Klusacek K., Technology Foresight in the Czech Republic, Discussion Paper Series, article 03-15, 2003

8. Mazurkiewicz A. (ed.) Techniczne wspomaganie zrównoważonego rozwoju. Kierunki badawcze i aplikacyjne. Instytut Technologii Eksploatacji – PIB, Radom 2011

9. Mazurkiewicz A., Poteralska B. Determining the priority research directions and key advanced technologies using foresight methods. In: Huizingh K. R. E., Conn S., Torkkeli M., Bitran I. (Eds.) Proceedings of The XXI ISPIM Conference, Bilbao, Spain 6-9.05.2010, ISSN 9789522149268

10. Mazurkiewicz A., Poteralska B. (eds.) Zaawansowane technologie przemysłowe i ekologiczne dla zrównoważonego rozwoju kraju. Wybrane zagadnienia. ITeE-PIB Radom 2011

11. National and Regional Key Technologies, European Foresight Monitoring Network, www.efmn.info, 2008
16

12. Poteralska B. Hierarchic Structure for Generation of Innovative Research Directions and Technologies, XXIII ISPIM Conference – Action for Innovation: Innovating from Experience, Barcelona, Spain, 2012.

13. Sacio-Szymanska A., Mazurkiewicz A., Poteralska B.: Setting priority R&D directions for the strategic research institutes. In: Huisingh K. R. E, Conn S., Torkkeli M., Bitran I (eds.) XXII ISPIM Conference. Sustainability in Innovation: Innovation Management Challenges, ISBN 978-952-265-091-7, Hamburg 2011.

BUILDING A TRIPLE HELIX CORPORATION: ORGANIZATIONAL INNOVATION FOR CROSS SECTOR RESEARCH COLLABORATION IN A CATCH-UP REGION

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Abstract
This paper studies an organizational innovation to foster research collaboration in a peripheral region. It uses a case study of a public-private corporation promoted by the Regional Government of Andalusia (Spain) that put together different types of firms and university research groups. It focuses on the process of building a new partnership taking into account its organizational features and the perspectives of industry stakeholders. Three types of information have been collected: qualitative interviews with industry managers, internal information provided by the corporation, and the results of an impact assessment. The findings show that this arrangement may incubate cooperative R&D in a regional environments characterized by low absorptive capacities, lack of trust and a cultural gap between science and industry. The results also show some limits related to the organizational design, the research orientation of the activities and the regional scope. The case study is used for informing the discussion on Triple Helix organizations regarding their possibilities for engaging partners with different expectations.

Keywords: cross sector research collaboration; university-industry relationships; organizational innovation; peripheral regions

TRIPLE HELIX RESEARCH COLLABORATION IN DEVELOPING TECHNOLOGICAL INNOVATION: THE CASE OF COMPUTER BASED INTERLOCKING

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Abstract
Computer Based Interlocking (CBI) is the most important part of the electric railway signaling system. CBI serves as the “brain” that controls the operation of electrical signaling system that replaces the role of the electromagnetic relay which has gradually been abandoned. Because of its very important function, the safety and reliability performance of a signaling system is largely determined by the CBI.
Development of CBI is based on the fact that until recently the signaling system in Indonesia is still relied heavily on the CBI products from foreign vendors. The use of foreign products leads to high dependence of foreign vendors that result in high cost of construction, operation, and maintenance of signaling system, the time length of development realization, and the limited service support. Therefore, the development of domestic CBI products is really necessary in order to decrease the dependence on technology from foreign vendors that at the same time is also be able to support the accelerated development of railway infrastructure in Indonesia. In addition, the domestic market opportunities, especially the requirement for a lot of mechanical signaling equipment, the development of double track, and the development of new pathways outside Java, also become a trigger for the development of CBI.
The CBI development is conducted in the form of a consortium involving the government, universities, and industry. This paper explores and analyzes the roles and interactions between different actors in the triple helix perspective, and identifies how the innovation ecosystem functioning with support from the government.
Based on the data collected through in-depth interview with the actors involved in the CBI case study, this paper provides an analytical insight from the real practice on how and why research collaboration brings success in the development of CBI technological innovation. The key finding is that the leader in the development of CBI technological innovation should be the industry supported by governmental research institutions and universities. It is because the industry has more knowledge about the needs of users than the governmental research institutions and universities. Another reason is because the industry has built its technology innovation capability from the previous programmable logic controller (PLC) based product development which has proven successful in the marketplace. Another important finding is that the presence of the government is required in the research collaboration to minimize the risk of technology failures which is possible to occur, and to accelerate the development of technological innovation.
Such findings may provide conceptual direction which is important for the development of technological innovation in Indonesia. In addition, in providing support for R&D activities, the government needs to direct to the industry that has a business and technology roadmap.
The possible further research may include some research issues. First, is the pattern occurred in the CBI case also applied in the other case of technological innovation development? Second, what obstacles can be identified in the development of technological innovation capabilities? Third, what is the impact of research collaboration in the development of technological innovation?

Keywords: Indonesia, Public-private research consortia, Multi-stakeholders dialogue, Industrial research, network modeling

1. Introduction

Computer Based Interlocking (CBI) is the most important part of the electric railway signalling system. CBI serves as the “brain” that controls the operation of electrical signaling system that replaces the role of the electromagnetic relay which has been abandoned gradually. Because of its very important function, the safety and reliability performance of a signaling system is largely determined by the CBI.
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The CBI development is conducted in the form of a collaboration involving the government, universities, and industry. The collaboration is a key for innovation process which can encourage interactions among firms, universities and R & D institutes (Inzelt, A. 2004). Moreover, Leydesdorff and Etzkowitz (1998) state that government is a rule-maker and facilitator of R&D, innovative activity and interaction.

Etzkowitz (2008) asserts that innovation has broadened from a focus on product innovation within firms to organizational changes within the triple helix. Within this triple helix, three main actors/organizations can be depicted: industry – academia – government. Within this model, industry plays the role as wealth generator, academia as a novelty producer, and government as representative of public control (Leydesdorff and Meyer, 2006).

In CBI case, industries, academia and government can play different role in encouraging innovation process as stated by Leydesdorff and Meyer (2006). Therefore, the important thing needs to be carried out is to explore and analyze the roles and interactions between different actors in the triple helix perspective, and to identify how the innovation ecosystem works well with the support of the government.

2. State of the Art

Leydesdorff and Etzkowitz (1998) propose the triple helix model to describe the dynamics existing in the institutional arrangements involving universities, enterprises and governments, and the relations between them occurred during the process of innovation. Leydesdorff and Meyer (2006) state that within this model, industry has a role as wealth generator, academia as a novelty production and government represents the public control.

Hewitt-Dundas (2006) finds that the ability of the small firm to innovate is related to collaboration. Not only small and medium sized firms but also large firms get benefit from collaboration, The correlation between innovativeness and the collaboration with various actors, such as universities, suppliers, customers, research institutions has been proven to be positive (Becheik et al, 2006).

Evidence suggests that government policies have a positive effect on innovation. Courvisanos (2009) recognizes the strong political focus on public innovation and provides a policy framework that identifies innovation policies formulated by the government. Furthermore, with the emphasis on the triple helix dynamics, Etzkowitz (2008) asserts that the role of government in the triple helix firm is at an embryonic state, and that its effectiveness is rather low.

Universities and research institutions have an important role on innovation (Vuola and Hameri, 2006). However, Drejer and Jorgensen (2005) argue that traditionally university and research institutes focus more on the provision of scientific and technical knowledge, not on the development of the innovation process of the firms.

Most facts revealed by Etzkowiz (2008), Leydesdorff and Meyer (2006), as well as Drejer and Jorgensen (2005) happen in developed countries. Roles played by industries, academia and government in encouraging innovation process can be different in developing countries including Indonesia. Therefore, this paper tries to verify the roles explained by Etzkowiz (2008); and Leydesdorff and Meyer (2006). This paper also tries to verify the focus of universities and R & D institutes as a provider of scientific and technical knowledge (Drejer and Jorgensen (2005). In other words, this paper explores and analyzes the roles and interactions between different actors in the triple helix perspective, and identifies how the innovation ecosystem works with support of the government.

3. Methodology

This study analyzes innovation process involving three actors (industry, academia, and government) in Indonesia. The innovation process analysis is a case study related to the development of CBI. Case study is the study of the particularity and complexity of a single case, coming to understand its activity within important circumstances (Stake, 1995). According to Yin, the strength of the case study is that it both covers a contemporary phenomenon and its context (Yin, 1981).

In identifying the roles and interactions between different actors in the triple helix perspective, and identifying how the innovation ecosystem works with the government support, this study uses in-depth interview and discussions with some collaboration members for three years. During that time, interview and discussions were carried out with related parties which consist of industries, academia and government. The interview and discussions were conducted with directors and managers of firms, government officials and researchers from government R & D institute, and universities.

4. Findings and Interpretation

Collaboration program on CBI involving industry, academia and government is initially based on a meeting held in 2008 in Ministry A. In that meeting, Ministry A and B have a vision to reduce the independency on imported technology especially for computer based train signaling system.

Institutions with the ability to develop the required system and technology are available in Indonesia. One company is engaged in a business of train signaling system with the technology capability of programmable logic controller (PLC) based product. In addition, there are two universities and one government R & D institution which can support the development of CBI.

The development of CBI is carried out collaboratively. In the model of R & D collaboration performed, industry is chosen as the leader. The reason is that industry has more knowledge about the user needs than the governmental research institutions and universities. Another reason for this is that the industry has built its technology innovation capability from the previous programmable logic controller (PLC) based product development which has proven to be successful in the marketplace.

The model to develop CBI is presented in figure 2. The model reflects the triple helix perspective which consists of elements of academia, industry and government. Initially, the collaboration model presented in figure 1 involves several agencies consisting of Ministry A, Ministry B and company X. Because of limited technical skills, subsequently the collaboration also involves a government R & D institution and two universities.

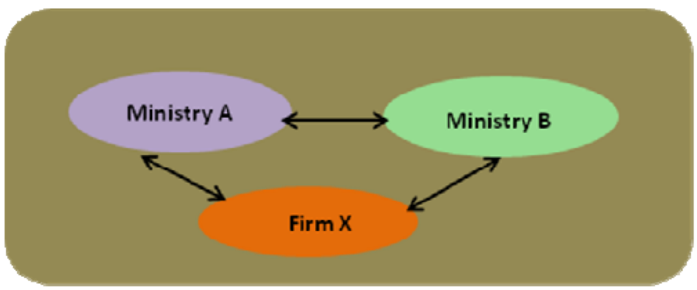

Figure 1. Initial Model

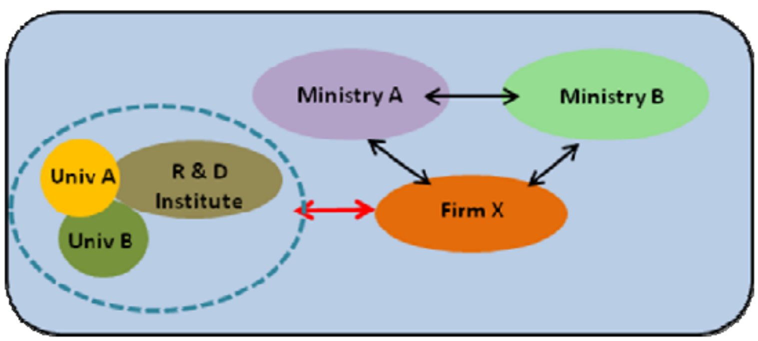

Figure 2. Triple Helix Model

Collaboration is carried out in the form of a research consortium. The research consortium is an effective forum for interaction among industry, academia and government. Technology users, policy makers and scientists can discuss together to decide the direction of science and technology development in the consortium. Dialogue among stakeholders in the public-private consortia may be an effective way to network and identify issues that hamper innovation. In the end, application opportunities are easier to identify when intensive interaction among actors who are also members of research consortium takes place (Roelofsen et al, 2010).

Table 1 shows the contribution of each member of the collaboration. Ministry A plays a role in providing incentives R & D and program coordinator. Ministry B provides funding for the implementation of the CBI, human resources to verify the CBI technology and user of resulted CBI. Firm X acts as a leader in research activities, the provider of funds and human resources (HR) for research. Government R & D institute plays a role in providing human resources to perform technology assessment of CBI. University A and B provide equipment and human resources for technology development.

Table 1. Collaboration Contributions

No	Institutions	Contribution				
		Funds	HR	Equipment	User	Technology Management
1.	Ministry A	√				√
2.	Ministry B	√	√		√	
3.	Firm X	√	√	√		
4.	Government R & D Institute		√			
5.	University A		√	√		
6.	University B		√	√		

The roles of government (Ministry A and B) are not only in the early stages, but also in the stage of implementation and utilization. Without the involvement of Ministry B in the implementation phase, the CBI innovation process will not run smoothly. In terms of funding contribution, the role of government is larger than industry. This fact is very different from the result of the study conducted by Etzkowitz (2008).

Based on this fact, the development of CBI will not be able to run smoothly without the support of the government. In the case of CBI, government plays a very important role in creating an ecosystem of innovation. The government role is not only in the provision of fund, but also in the implementation and utilization of CBI.

Time required to finish the technology development is relatively predictable. The development by the company without any collaboration, will take longer time due to limited research funding and human resources, as well as technological capability. With this collaboration, it can be finished much faster. The program lasts four years starting from 2009 and will end in 2012 with the installation of this technology at one station in the area of Central Java.

In terms of research development, the role of industry is also very important since the industry has possessed prior knowledge on railway signaling technology. Government research institution and universities gain a lot of technical and practical knowledge from the industry. In the early stage of collaboration, the reality is different from what is revealed by Drejer and Jorgensen (2005). However, at later stage, the industry acquires lot of knowledge, especially on the methodology of technology development from universities. Meanwhile, the government R & D institute acts an assessor of CBI technology in which the results of the assessment are very important for the standardization of the CBI product.

Collaborative program of CBI development has produced a variety of technological capabilities such as the ability of integration, and development of software and components. The technological capability has resulted in a product output as planned with the domestic component estimated above 60%.

5. Conclusions

From the findings in developing CBI, some conclusions drawn are as follows:

- Roles of government are very important in establishing an innovation ecosystem. The presence of the government is required in the research collaboration to minimize the risk of technology failures which is possible to occur, and to accelerate the development of technological innovation. Moreover, government roles in developing CBI are not only in an early stage, but also in an implementation and utilization stage of CBI. Ministry A has a function as a R & D incentive provider and program coordinator. Ministry B provides funding to implement CBI, human resources to verify the technology, and user of the CBI. Firm X has a role as a leader in R & D activities, provider in funding and human resources for R & D activities. Government R & D institution provides human resources to conduct an assessment on CBI with the aim to 10 standardize CBI product. University A and B provide human resources and equipments to develop CBI.
- Leader in the development of CBI technological innovation should be the industry supported by governmental research institutions and universities. The reason is that the industry has more knowledge about the user needs than the governmental research institutions and universities. Another reason is that because the industry has built its

technology innovation capability from the previous programmable logic controller (PLC) based product development which has proven to be successful in the marketplace.
- Research consortium is an effective vehicle to make interactions among industry, academia and government take place. Technology users, policy makers and researchers can talk together to decide the direction of science and technology to be developed. Dialogue among involved parties in public-private consortia can be an effective way in building collaborations and identifying some problems emerged for innovation.

6. Policy Implications

With the technological capability owned by related parties, collaboration program on the CBI development has produced a product output as planned. Therefore, in providing support for R&D activities, the government needs to direct its R & D incentives to the industry that is engaged directly in the business and has technology roadmap. The reason is that the industry has more knowledge about the user needs than the governmental research institutions and universities.

7. Directions for Further Research

The possible further research may include some research issues. First, is the pattern occurred in the CBI case also applied in the other cases of technological innovation development? Second, what obstacles can be identified in the development of CBI technological innovation capabilities? Third, what is the impact of research collaboration in the development of CBI technological innovation?

References

Becheikh, N., R. Landry, N. Amara. (2006). Lessons from innovation empirical studies in the manufacturing sector: A systematic review of the literature from 1993-2003. *Technovation* 26 (5-6) : 644-664.

Courvisanos, J. (2009). Political aspects of innovation. *Research Policy* 38 (7) : 1117-1124.

Drejer, I. and B. H. Jorgensen. (2005). The dynamic creation of knowledge: Analysing publicâ€“private collaborations. *Technovation* 25 (2) : 83-94.

Etzkowitz, H. (2008). *The triple helix: University-industry-government Innovation in action.* New York : Routledge.

Hewitt-Dundas, N. (2006). Resource and capability constraints to innovation in small and large plants. *Small Business Economics* 26 (3) : 257-277.

Inzelt, A. (2004). The evolution of university–industry–government relationships during transition. *Research Policy* 33 : 975–995.

Leydesdorff, L., H. Etzkowitz. (1998). The triple helix as a model for innovation studies. *Science and Public Policy* 25 : 195–203.

Leydesdorff, L. and M. Meyer. (2006). Triple helix indicators of knowledge-based innovation systems: Introduction to the special issue. *Research Policy* 35 (10) : 1441-1449.

Roelofsen, A., W. P. C. Boon, R. R. Kloet, and J. E.W. Broerse. (2011). Stakeholder interaction within research consortia on emerging technologies: Learning how and what ? *Research Policy* 40 : 341-354.

Stake, R. E. (1995). *The Art of case study research*. Thousand Oaks, CA : Sage Publications.

Vuola, O. and A. P. Hameri. (2006). Mutually benefiting joint innovation process between industry and big-science. *Technovation* 26 (1) : 3-12.

Yin, R. K. (1981). The Case study as a serious research strategy. *Knowledge* 3 : 97-114.

COLLABORATIVE NETWORKS AND SUSTAINABLE BUSINESS: A CASE STUDY IN THE BRAZILIAN SYSTEM OF INNOVATION

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Abstract
This paper presents a management model designed to articulate the different actors from Brazilian innovation ecosystem aligned to business strategy. This model was developed and is being validated by a Brazilian company called Natura, a consumer goods industry leader in the cosmetic sector in Brazil and that has operations in six other Latin American countries (Argentina, Bolivia, Chile, Colombia, Mexico and Peru), and France. Natura investments in innovation increased from US$ 44.07 million in 2008 to US$ 83.84 million in 2010. The methodology of this study was inspired by good practice search, following the approach suggested by Slowinski and Sagal (2010). Also, it was based on previous company experience and its technology planning, activity that within the company aims to assess trends (consumption, market and technology), build product roadmaps, research and innovation programs, map and evaluate technical competences and its related gaps in order to achieve the innovation strategy. The collaborative networks and partnerships management model was designed to meet the innovation strategy by assessing competences in the external network of partners and by articulating universities, companies and governments in a single framework. This occurs through the integration of four processes that aim to form, to strengthen and connect innovation networks.

Keywords: innovation management, university-industry interaction, funding for innovation, good practices, Brazil

STIMULATING R&D AND INNOVATION: A STRATEGIC RESPONSE TO ROMANIA'S ECONOMIC CRISIS

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Abstract
This paper discusses the effects of the global crisis on the Romanian economy and on the R&D and innovation system, in particular, and the set of anti-crisis measures adopted by the government in the attempt to contain the damage. Notably absent from the anti-crisis package were measures in support of R&D and innovation, a sector that was heavily affected by the crisis and that could have had a significant potential to contribute to the economic recovery if supported by adequate policies and funding schemes. We argue that, learning from the missed opportunities of the recent years, bold and integrated measures in support of R&D and innovation need to be adopted in the country in the short- to medium-term, in order to speed up the economic recovery and realise a significant national and regional innovation potential that has been largely underexploited so far. Two key measures to this end are extending the government's public infrastructure investments into the R&D and innovation infrastructures, and creating the legal and operational framework for a regional R&D and innovation system, which is currently lacking.

Keywords: economic crisis; R&D; innovation; regional innovation policies; anti-crisis measures; European Structural Funds

1. Introduction

The key role of innovation and technology in promoting economic change is documented in a vast body of academic literature that builds on Schumpeter's earlier work viewing the entrepreneur as an agent of economic change, up to his later contributions stressing the role of large firms as main drivers of innovation (Schumpeter 1934, 1942). Innovation scholars (e.g. Freeman, 1974, 1987; Dosi, 1988; Cohen and Levinthal, 1990); Lundvall, 1992; Nelson, 1993; Mowery and Nelson, 1999; Baumol, 2002) highlighted a variety of innovation-related organizational learning and knowledge accumulation processes, both within and outside the firms, in their interaction with the external environment. Also, the economic benefits of publicly-funded research for industry and technological innovation have been reflected in several streams of literature, such as: (i) increasing the stock of knowledge (Gibbons and Johnston, 1974; Mansfield, 1991; Klevorick et al., 1995; Narin et al.; 1997; Meyer-Kramer and Schmoch, 1998; Nelson and Rosenberg, 1994; Santoro and Chakrabarti, 2002); (ii) training skilled graduates (Salter and Martin, 2001); (iii) creating new instrumentation and methodologies (Rosenberg, 1992), De Solla Price , 1984; Riggs and Von Hippel, 1994); Brooks, 1994); (iv) forming networks and stimulating social interaction (Faulkner and Senker, 1994; Murray, 2004; Clarysse et al., 1996; Balconi et al. 2004); (v) creating new firms (Clarysse et al., 2001; Saegusa, 1998). These benefits have been significantly affected by the financial crisis that originated in the US economy in 2006-2007 and turned into a global economic crisis since 2008, causing a decline in R&D and innovation investment, a sharp increase in bankruptcies and business failures, a drop in the number of new firms, cash flows and foreign direct investments (FDI), a reduced access to financing, depreciation of human capital and lower support to the 'green economy' (OECD, 2009). At the same time, however, the downturn also offered opportunities to enhance innovation and accelerate structural changes that are more difficult to achieve in the upturn - a philosophy that determined a majority of governments in the European Union (EU) and beyond to maintain or even increase their R&D budgets during 2008-2009 and place R&D high on their economic recovery strategies (European Commission, 2011a).

Romania, one of the EU's New Member States since 2007, was among the few countries where the public R&D and innovation budget was drastically reduced since 2008 - a decision that generated severe short-to medium term damages to the R&D and innovation system, with consequences difficult to assess in the long term. The economic crisis in Romania manifested all the three features characteristic to major recessions (Archibugi and Filippetti, 2012): (i) it emerged in a unique macroeconomic environment, causing a deep plunge in demand, great difficulty in obtaining credit and discontinuities in technology and markets; (ii) it was rare and difficult to anticipate; and (iii) it generated a profound change in the economic system, due to changes in the long-term patterns of economic growth, technical change and employment opportunities. In a veritable Keynesian tradition, the Romanian government's anti-crisis response was focused on massive public investments in infrastructure (transport, energy, environment, education, agriculture, health), as well as on a series of fiscal and social protection measures, but paid virtually no attention to R&D and innovation, which have a low visibility and importance in the country.

In this paper, we analyse the crisis effects on the Romanian economy and on the R&D and innovation system, in particular, and discuss the anti-crisis plan adopted by the government and its limited effects, noting the lack of focus on R&D and innovation measures. Our analysis concludes with a set of measures aimed to enhance R&D and innovation at the national and regional level, in view of accelerating the country's economic recovery and catalyse the renewal of the R&D and innovation system in a process of creative reconstruction that would counteract the "creative destruction" of the recent years.

2. The effects of the economic crisis on the Romanian economy

After several years of sustained growth in the 2000s, with fast-rising GDP growth rates from 2.4% in 2000 to 7.3% in 2008 (Eurostat), making Romania one of the most dynamic economies in Europe, the country began to feel the effects of the global economic downturn in the second half of 2008. In the early months of 2009 the crisis impact was already much stronger than expected, and the state of the economy worsened by the end of the year, plunging the GDP annual growth rate to -7.1% (Eurostat***). The*** fast spread of the global crisis effects into the Romanian economy was due to its wide exposure to the EU market, which absorbs about 70% of Romanian exports and was one of the most affected zones, as well as to other international markets. ***The crisis revealed*** the country's low resistance to external financial shocks, as well as internal economic weaknesses of structural, institutional and managerial nature that had aggravated in the downturn.

The boom fuelled primarily by foreign direct investment (FDI), consumer spending and capital inflows to local subsidiaries of foreign banks, was no longer sustainable when the global credit crunch reduced FDI inflows to the country by 63.3% in 2009 compared to 2008 (National Bank of Romania, 2009), and the banks reduced considerably their lending to local firms and individuals. A 15.21% depreciation of the national currency to the euro in the first semester 2009 relative to the first semester 2008 (National Council of Romanian SMEs, 2009) made it more expensive for private consumers to service their loans, as over half of domestic private credit was in foreign currency, but also for companies, whose lending activity in euro was in many cases brought virtually to a standstill. Many multinational banks introduced better credit standards for foreign companies and favoured resident companies from their home countries over local firms.

The crisis hit hard the private sector, both large firms and SMEs. For example, large firms in the iron and steel sector, owned by major international corporations, such as Arcelor Mittal, Mechel, TMK and Tenaris, have gone "from ecstasy to agony" (Radio Romania International , 2009) from the first nine months of 2008, when exceptional profits were reported, to October 2008, when profits dropped by hundreds of millions. They were followed in subsequent months by massive lay-offs, redundancies and temporary closure of production facilities caused by a large decrease in exports demand and in sales. The car industry was also significantly affected, with car sales falling by nearly 50% in the first five months of 2009 (Ravoiu, 2009). The textiles, garments and footwear production dropped by 6.2% in 2008, over 60,000 textiles industry workers were made redundant in 2008 and 300,000 more were expected by the end of 2009, along with the disappearance of about 20% of companies working in the lohn system (Radio Romania International 2009a).

SMEs have also felt the economic and financial effects of the crisis. ***Half of Romanian SMEs were*** "catastrophically" or "very highly" ***affected, and only 2% were not affected at all, according to an April 2009 survey conducted by the National Council of Romanian SMEs (Mediafax, 2009). A*** six-monthly evaluation of Romanian SMEs in the first semester 2009 highlighted for the first time a negative value of the entrepreneurial index[1] compared to the same period of 2008, reflecting a "very unsatisfactory" evolution of the business environment and SMEs sector (National Council of Romanian SMEs, 2009). ***The most severe decline was felt by companies in tourism and manufacturing, while transport companies had a relatively***

[1] The entrepreneurial index is determined as a weighted average of three indexes: the business environment index, the SMEs index and the entrepreneurs' assessment index.

constant performance, and some service firms managed to increase their activities (National Council of Romanian SMEs, 2009a).

The causes for SMEs' bankruptcies were multiple, most of them pertaining to dysfunctions in the country's economic, financial and political system: unclear and fast-changing economic and financial regulations, high bureaucracy, corruption, political instability, unfavourable business environment, with a lack of protection measures for domestic capital, reduced access to credits and cash flow blockages caused by unpaid debts of the state to the private sector, and of the firms facing financial deficits to other firms. Domestic market turbulences had consequences on declining exports, internal demand and investments, sudden rises in the price of raw materials, energy and food, and depreciation of the national currency. A 'psychological effect' was also observed, inhibiting the planned or ongoing investments in SMEs (ibid).

The crisis also hit hard the public sector, but here the dynamics was different from that in the private sector. Private sector employment declined by approximately 281,000 from 2008 to 2009, while public sector employment went up by approximately 9,000 (National Institute of Statistics, 2012a). A small part of the private sector lay-offs were absorbed in the public sector, estimated to have expanded by 5.5% in 2009, but most went into unemployment, so that the unemployment rate nearly doubled from 4.4% in 2008 to 7.8% in 2009 (National Institute of Statistics, 2012) and to 8.1% in 2010 (National Agency for Employment, 2012).

The expansion of the public sector continued until Q1 2010, when the first signs of lay-offs emerged here too, but were still much below those in the private sector. The Romanian public sector continued to be one of the most oversized relative to other EU countries, accounting for 32% of the employed population in 2010, compared to 19% in Italy, 21% in the UK and 26.5% in Poland (Lungu, 2010). Rising salary levels in the public sector triggered salary rises in the private sector, but public sector salaries remained higher, putting increasing pressure on the public budget, where salary expenditures almost tripled in 2008 and 2009 relative to 2007. With large accumulations of public budget deficit from -2.9% in 2007 to -9.0% in 2009 (Eurostat), the 6.8% budget deficit set by the government for 2010 was an ambitious target, which required the adoption of tough measures in order to be met. To this end, the decision to reduce public expenses and broaden the tax revenues level was adopted by the government in June 2010. The decision was implemented through a 25% cut of salaries in the public sector, a 15% cut of social security expenses and a reduction of government arrears, in parallel with an increase of VAT from 19% to 25% and a 3% increase of social security contributions, with effect from July 2010. The measure was followed by a cut of approximately 110,000 jobs in the public sector in 2009-2010, in the expectation that the budget deficit will continue to go down to 4.7% of the GDP in 2011 and below 3% in 2012 (European Commission, 2011). However, in spite of achieving some budgetary corrections, this way of reducing fiscal deficit ultimately reduced the population consumption capacity, affecting thus the chances of this factor to contribute to economic recovery as it contributed to economic growth before 2008. This decision came in the context of a broader package of anti-crisis measures initiated by the government in 2009 and 2010, which had only a modest success, as will be shown in the next section.

3. The anti-crisis measures of the Romanian government

The first anti-crisis plan of the Romanian government, also known as the "Joint platform of anti-crisis measures", was launched in January 2009 as a EUR10.5bn package of 74 economic-financial, social and sectoral measures. Most noteworthy measures were the allocation of a massive 20% of the 2009 public expenditure (7% of the GDP) for public investment in transport, environment, health, education, agriculture, tourism and residential infrastructure - the highest public investment allocation in the last 20 years. Also, re-invested profit and dividends were proposed to be tax exempted starting from Q2 2009. The support package for SMEs included: improved access to financing, creation of a SME credit guarantee and counter-guarantee fund and increasing of state pre-financing for SMEs accessing European Structural Funds, increase of state aid (de minimis aid) for SMEs to max. EUR 200,000, creation of the Agency for Implementation of Projects and Programmes for SMEs, etc. Other measures with broader economic impact were also adopted, such as support to exports through a state capital injection into two state banks (CEC and Eximbank) amounting to 0.2% of the GDP, integral state subvention during 2009 of employers' contribution to social security for monthly salaries of max. RON 1,000/person (approx. EUR300) in order to stimulate the creation of minimum 50,000 jobs in micro-enterprises; export orientation to emerging countries; simplification of administrative procedures for firms; capital injections and supportive measures for the auto, petrochemical and mining industries, etc.

In July 2009, six months after launch, an assessment of the anti-crisis plan by the Prime-Minister claimed a successful implementation, with only four measures left in progress due to pending approvals or procedures: the tax exemption of re-invested profit and the capitalization of CEC Bank (subject to approval by the European Commission and the IMF), public-private partnerships (guidelines under approval at the line ministries) and supplementing of the R&D and innovation budget, to be achieved in a future budgetary rectification (Government of Romania Press Office, 2009a). In practice, however, the effects of the anti-crisis plan were modest, due to implementation flaws, late implementation of some measures or no implementation at all of the four measures mentioned above. The effectiveness of public infrastructure investments, some of which were co-financed by European Structural Funds, was reduced by delays in getting the necessary funding from the state, the banks or the Structural Funds. There was no clear evidence of new jobs created as a result of the anti-crisis plan, although an estimated 90,000 jobs were said to be preserved, and 5,200 SMEs saved from bankruptcy by the implementation of the credit guarantee and counter-guarantee fund created in 2009 (Government of Romania, 2010). Also, in spite of the increased state pre-financing, the absorption of European Structural Funds remained very low, which reduced considerably the relevance of the measure, since it only applied to a very limited number of projects. Moreover, the anti-crisis plan was considered to potentially generate more crisis effects instead of reducing them, by crowding all the investments foreseen for Q4 2009 in Q3 2009 in the attempt to recuperate delays in the investment spending for 2009, and by overloading payments from the state budget for the works due for completion in 2010 (Hainarosie, 2009). The plan was also widely contested by the business community and the General Union of Romanian Industrialists (UGIR-1903) appreciated the general effects of the plan as "non-existent" (Newschannel, 2009).

A second set of anti-crisis measures was announced by the government in August 2009, as an additional package foreseen to take effect from 1 January 2010. It included measures that had not been realised in the previous plan, such as the tax exemption of the re-invested profit, or were continued[2]. The effects of these measures were also limited, as the new fiscal measures introduced at the same time increased the bankruptcy risk for firms, especially SMEs. A survey of 2,000 SME managers undertaken in October 2009 by the National Union of Romanian Employers revealed a general pessimism of the private sector about the country's economic recovery chances in 2010, and a worsening of SMEs' situation as a result of job losses, restructuring of personnel, market contraction and political instability (National Union of Romanian Employers, 2009).

In a context where both the economic situation of the region and that of the national economy had worsened, the government turned to the EU, the International Monetary Fund (IMF), the World Bank and other international donors for help. A EUR 20bn loan was granted within the 2009-2011mid-term financial assistance programme concluded between the Romanian government and the European Council in May 2009, consisting of a EUR 5bn loan from the EU, a EUR 13bn loan from IMF, a EUR 1bn loan from the World Bank, and a EUR 1bn loan from the European Bank for Reconstruction and Development. As a condition for receiving this loan, the government was asked to implement an adjustment programme for consolidating public finances and ensuring macro-economic stability (European Commission, 2011). The programme covered three main areas: fiscal consolidation, banking reform and reducing inflation to help restore financial stability, and also included a series of social protection measures. The adjustment programme was considered to be successfully implemented (European Commission, 2011) and was followed in March 2011 by a 24-month EUR 3.5bn precautionary stand-by agreement, in conjunction with precautionary support from the EU of EUR 1.4bn and a loan from the World Bank of EUR 0.4bn (IMF, 2011).

4. *Economic crisis effects on the Romanian R&D and innovation sector*

In the overview of anti-crisis measures adopted by the Romanian Government discussed above, measures in support of R&D and innovation are notably absent, with the exception of the intended increase of the R&D and innovation budget in the first set of anti-crisis measures, which was not realised. On the contrary, the R&D and innovation budget saw dramatic cuts in 2009 and 2010, as we will see below. The lack of focus on R&D and innovation in Romania as important drivers of economic recovery contrasts with the approach adopted by many EU and non-EU countries that

[2] E.g. export support through government guarantees and counter-guarantees provided by Eximbank, state aid schemes for the SMEs hit by economic crisis and for firms in strategic industry sectors (agriculture, constructions, infrastructure, tourism, environment and health), extension of the car-scrapping scheme, improvements in the Investment Law, guarantees for the credits contracted by youth in the social housing programme 'First Home', support to agricultural production and cancellation of several fiscal taxes and tariffs (Government of Romania Press Office, 2009b).

placed R&D and innovation policies high in their economic recovery strategy and allocated significant support to this end (OECD 2009).

The lack of focus on R&D and innovation reflects the little visibility and importance actually given to this area, although R&D and innovation have been recognized as priority strategic areas in all the government programmes after 1990, including the 2009-2012 Government Programme (Government of Romania, 2008) that was in effect at the time of the adoption of the anti-crisis plan. In addition, even if the government's anti-crisis plan placed infrastructure investments at the top of financial allocations, similarly to other countries, the 7% share of GDP allocated to this spending item with no provision for R&D and innovation, is, however, disproportionately high, even considering that some overlapping with the other categories, like education (primarily construction or modernisation of schools) might be included in this share. This disproportionate allocation of public resources to infrastructure investments in transport, agriculture, health, tourism, etc. at the cost of sharp cuts in the R&D and innovation system not only had serious damaging effects on this sector in the short-term[3], but is also likely to affect the medium- to long-term development perspectives of the Romanian R&D and innovation system, which *"…is in a silent crisis, with seriously negative implications for the country's longer term competitiveness and growth prospects...Romania's government and private sector are investing too little in R&D and innovation, and, perhaps as importantly, often investing it poorly"* (World Bank 2011, p. 7).

As mentioned earlier, the R&D and innovation budget increase included in the first anti-crisis plan not only was not realised, but this budget category was one of the hardest hit by the economic crisis, Romania recording, next to Latvia, the most severe cuts among EU Member States in this area (European Commission, 2011a). After a 7.9% annual average real growth of the gross expenditure for R&D (GERD) during 2000-2008 at a steady pace from 0.37% in 2000 to 0.58% of GDP in 2008, a sharp drop to 0.47% occurred in 2009 and 2010 (Eurostat). Romania became thus one of the seven EU Member States[4] that decreased their R&D budgets in 2009 compared to 2008, in contrast to 17 other Member States were able to maintain or increase their R&D budgets over the same period (European Commission, 2011a). The drop in GERD in 2009 relative to 2008 was accompanied by a 0.10% drop in the R&D intensity in the same period, further reducing this indicator that was already at less than a quarter (0.48) of the EU27 average during 2000-2009 (2.01). A much sharper decline (-32.4%) was recorded in the public expenditure on R&D[5] that determined a 0.12% fall in the public sector R&D intensity between 2008 and 2009 (*ibid.*) It is also interesting to note here the dynamics of Romania's R&D intensity in 2000-2009: in contrast to the majority of EU Member States, where R&D intensity grew at a slower pace (annual average) in the period 2000–2006 than in the period 2006–2009, Romania experienced a rapid increase in R&D intensity during 2000–2006 (3.68%) and slowed down during 2006-2009 (1.83%) (*ibid.*), as an effect of the gradual GERD increases during 2000-2008 by the Romanian Government in pursuance of the Barcelona target of 1% of GDP by 2010.

In the innovation area, the situation is no less concerning. Public budget cuts affected innovation developments in a context where the country's innovation performance was already one of the lowest in the EU. Indeed, in spite of steady improvements in recent years[6], the country ranked 23rd out of 27 EU Member States in terms of innovation performance and was part of the *'Modest Innovators Group'* defined by the 2010 Innovation Union Scoreboard (ProInno Europe 2011). The 2011 Innovation Union Competitiveness Report (European Commission 2011a) places Romania in the *Group of low knowledge capacity systems with a specialisation in low knowledge-intensive sector,* next to Bulgaria, Poland, Turkey and Croatia, with a share of Knowledge-Intensive Activities (KIAs) below 20% of

[3] 2,088 certified researchers and 195 PhDs lost from 2008 to 2009 (NASR 2010, p. 4), especially in the national R&D institutes, weakened capacity to attract young researchers and stop the brain-drain abroad or towards better paid domestic sectors, temporary freezing of several components of the National RDI Plan, weakening or dissolution of public-private partnerships, etc.
[4] Belgium, Estonia, Ireland, Italy, Latvia, Lithuania and Romania.

[5] Government R&D expenditure (GOVERD) and higher education R&D expenditure (HERD)
[6] Romania's Innovation Union Summary Innovation Index rose from 0.195 in 2006 to 0.237 in 2010 at an average annual growth rate of 5.23%, which placed the country among the growth leaders in its group and also among the overall growth leaders.

total employment in 2009, and a 24.4% share of employment in high- and medium high-tech industries and in knowledge-intensive services, significantly below other EU27 Member States (30%-55%).

Innovation in the private sector is weak and has been further weakened after 2008, as shown by the significant decline in the share of enterprises with technological innovations in industry and services in the period 2008-2010, reaching the lowest level since 2002 (National Institute of Statistics, 2008, 2012b).

Private R&D investment (BERD) dropped to values between 0.17% - 0.19% of GDP in 2008-2010, after a period of relative stability during 2000-2007 at approx. 0.22% (Eurostat). Another contributing factor to these low innovation levels is also the slow translation of R&D into innovation at the science-industry interface. On the one hand, the process is hindered by the low absorptive capacity of industry and low BERD levels. On the other, the relatively low academic research performance, unevenly distributed among universities, and the early development stage of technology transfer infrastructures in the national network of technology transfer and innovation institutions ReNITT[7] and in universities, are significant factors. Technology transfer in universities is a relatively recent activity and only a few universities (primarily the leading academic centres in the large cities Bucharest, Timisoara, Iasi and Brasov) have developed their own technology transfer offices. The creation of university spin-offs based on recent research results, patents or licenses is in its infancy, and has been further hindered by the lack of capital and difficult access to bank financing determined by the economic crisis. Moreover, the fuzziness of the intellectual property regulatory framework and its application, and the lack of technical and financial assistance to start-up firms applying innovations from Romanian R&D added further obstacles to the technology transfer process. As a result, technology transfer from universities to firms is generally very limited, due to a low demand from industry and also a weak offer from universities (see NASR 2010, p. 57)

The contribution of large foreign R&D investors to the Romanian R&D and innovation system is also very limited. Such investors are present in Romania especially in the ICT industry, where most of the global technology corporations are represented (Intel, Motorola, Sun Microsystems, Boeing, Nokia, Oracle, Microsoft, IBM, Alcatel – Lucent, Hewlett-Packard, Google, Siemens, etc.). Most of them intensified their software development activities and opened R&D and innovation centres (e.g. Microsoft Innovation Centre in Bucharest). However, the R&D content of these large multinationals' activities in Romania is rather low and is focused on support activities and call-centres (very low R&D content), adaptation of solutions for the Romanian market (no R&D content) and some ICT R&D carried out in non-ICT sectors (e.g. Renault R&D investment in Arges county). R&D employees account for about 10-20% of the total employees and are concentrated in the headquarters R&D teams, having only a limited local innovation effect (Baltac, 2009).

5. Conclusions and recommendations

In the attempt to counteract the effects of the global economic and financial crisis that became visible in Romania in the second half of 2008, the government adopted a set of anti-crisis measures that proved to have a modest success. The worsening economic and financial climate in the region and the lack of significant improvements in the national economy, determined the government to ask the help of the EU, the IMF, World Bank and other international donors, who granted a EUR 20bn loan, conditioned by the implementation of a comprehensive fiscal and structural re-adjustment programme. Notably absent both from the government's anti-crisis package and the re-adjustment programme monitored by the European Union and IMF were measures in support of R&D innovation, a sector that was heavily affected by the crisis and that could have had a significant potential to contribute to the economic recovery, had it been supported by adequate policies and funding schemes. We argue that, learning from the missed opportunities of the recent years, bold and targeted measures in support of R&D and innovation need to be adopted in the country in the short- to medium-term, in order to speed up the economic recovery and realise a significant innovation potential, both at the national and at the regional level that has been largely underexploited so far. Two key measures that could be implemented to this end include:

[7] ReNiTT is the network of technology transfer and innovation institutions that provide various services of technology information, counselling, training and technical assistance to public RDI units and enterprises, especially innovative SMEs. In 2011 ReNITT included 54 accredited entities: 14 technology transfer centres, 20 information technology centres, 16 technology and business incubators and 4 S&T Parks (Tanase, 2011).

a. An extension of government's strong public infrastructure investments into the R&D and innovation infrastructures.

The 2007-2013 National R&D and Innovation Strategy prioritizes the development of R&D and innovation infrastructures, but the funding provided for this objective through the Strategy's main implementation tool - the 2007-2013 National R&D and Innovation Plan - has been drastically reduced at the end of 2008, so that about 1/3 of the planned investments in this area have not been finalised in 2009 (NASR, 2009). In 2010, the budget for research infrastructures was again modified or temporarily ceased, and some programme components, which were meant to develop innovation support structures and services, quality management and infrastructure have not been activated (NASR, 2010). A certain compensation of the decline in the national funding was expected to be achieved through a higher absorption of Structural Funds allocated for R&D and innovation infrastructures through some operations of Priority Axis 2 of the Sectoral Operational Programme 'Increasing Economic Competitiveness' and Priority Axis 4 of the Sectoral Operational Programme 'Regional Development' (for regional and local business support structures, e.g. industrial, business parks, business incubators etc.). However, this compensation has not been significant in 2009-2011 and, in order to make it significant in the coming years, greater efforts to improve the management and implementation of the SOPs are necessary. Moreover, the application of domestic research solutions and technologies to the envisaged public infrastructure investments in many areas (transport, energy, environment, health, agriculture, ICT, etc.) could be given a stronger support, increasing thus the internal demand for such solutions and the mobilisation of domestic human and material resources for high-priority national and regional objectives.

b. Create the legal and operational framework for a regional R&D and innovation system

Currently, regional innovation policies do not exist in Romania, although their necessity and opportunity is supported by several factors, such as the strong regional imbalances in the distribution of R&D and innovation resources, which are heavily concentrated in the capital region Bucharest-Ilfov (Eurostat; National Institute of Statistics, 2012c). The R&D and innovation policy mix and programmes are designed and implemented only at the national level by the National Agency for Scientific Research (NASR) - the key government agency responsible for the RDI field. NASR has, however, a limited regional outreach and has adopted an incipient regional focus in the implementation of national R&D and innovation policies only since 2008[8]. The eight development regions of the country, defined according to the European Union's NUTS 2 nomenclature have no role in R&D and innovation policy-making. They are only territorial units for which regional development policies are implemented in view of efficient use of Structural Funds, and have no administrative status.

The first regional innovation instrument emerged in Romania in the early 2000s in the form of the *Regional Innovation Strategies (RIS)* that have been developed by six Romanian regions with FP6 support, on the basis of their affiliation to the Innovating Regions in Europe (IRE) Network. However, the RIS have only an orientation purpose and are not seen as part of a regional innovation policy or as having a mandatory character. The RIS are managed by Regional Development Agencies (RDAs), which are non-governmental organisations with delegated authority from the central government (Ministry of Regional Development and Tourism) to coordinate regional development and implementation of Structural Funds disbursed through the Sectoral Operational Programme 'Regional Development' (Regio Programme). The RDAs are authorized to design and implement regional development strategies, implement the national policy on regional development and collaborate with the local administration to identify less favoured areas to invest in, as a measure of decentralisation of regional development funds. However, innovation is outside their remit. Consequently, they are not recognized as a regional innovation authority, although in practice, they exert, albeit with modest success, some of the attributions of such an authority, such as the coordination of some regional development projects that have a strong innovation dimension. In effect, the RDAs find themselves in an institutional and policy vacuum at the intersection of regional development and innovation, two sectors coordinated by central government agencies (Ministry of Regional Development and Tourism and NASR, respectively) that have little

[8] This consists of: monitoring regional distributions of projects funded by the 2007-2013 National RDI Plan, nine regional Research Exhibitions, an Innovation Roadshow, production of Innobarometer as an annual analysis of regional innovation

coordination and synergies among them. The Ministry of Regional Development and Tourism coordinates regional structures (the RDAs), but has no innovation responsibilities, while NASR, who is responsible for innovation policies, has no regional policies and a limited territorial outreach. The RDAs, which can act as a bridge between the two areas, are very limited in doing so and lack the authority and instruments for more substantive action.

Advancement towards the introduction of regional innovation policies would imply an extension of the decentralization, currently existing in other sectors, like pre-school and pre-university education, health, child protection, social protection, etc., into the R&D and innovation area - a change allowed by the existing legal framework (Dragnea, 2012)[9]. Further steps could include the creation of R&D and innovation local public authorities, authorised to design and implement own policies within an appropriate institutional set-up, definition of regional R&D and innovation priorities, objectives, targets, policies, programmes, budgets, implementation procedures, formation of human resources and collaboration with other regions within the country and internationally. The experience accumulated by the RDAs could be a useful asset to rely upon in this process, and could serve as a good starting point in the creation and consolidation of a regional R&D and innovation system.

All these recommendations, while ambitious and challenging, also have the potential to bring the Romanian R&D and innovation system a significant step further on the path of reform and modernisation started in the early 1990s, and accelerate the country's economic recovery. They require a clear and determined top-down vision and political will to bring to life integrated policies and implementation procedures, as well as decisive bottom-up initiatives reflecting the local and regional needs and priorities. The difficulties created by the economic crisis in the R&D and innovation system, so far often manifested through a "creative destruction" (Schumpeter, 1942) could thus catalyze a process of creative reconstruction, by integrating old and new policy, technology and organizational elements into new configurations through concerted action of R&D and innovation stakeholders at national and regional level, in national R&D institutes, universities, business firms and many other organizations. The crisis provides thus an opportunity for renewal and improvement that is indeed too good to miss.

References

Archibugi, D. and A. Filippetti (2012). Innovation and the economic crisis. Lessons and prospects from the economic downturn, Oxon and New York: Routledge.

Balconi, M., S. Breschi and F. Lissoni (2004). Networks of inventors and the role of academia: an exploration of Italian patent data, Research Policy, 33 (1), 127-145.

Baltac, V. (2009). ICT - R&D Internationalisation: Romanian Experiences. Presentation at the 'Internationalisation of ICT R&D' workshop, Seville, 22 October 2009.

Baumol, W.J. (2002). The Free-Market Innovation Machine: Analyzing the Growth Miracle of Capitalism. Princeton University Press.

Brooks, H. (1994). The relationship between science and technology, Research Policy, 23 (5), 477-486.

Bucharest Chamber of Commerce and Industry (2009). Leading edge technology for SMEs through the ROMNET-MINAFAB network. Press Release, 27 May 2009.

Clarysse, B., A. Heirman and J.-J. Degroof (2001). Het fenomeen spin-off in België, IWT-Observatorium.

Clarysse, B., K. Debackere and M. A. Rappa (1996). Modelling the persistence of organizations in an emerging field: the case of hepatitis C, Research Policy, 25 (5), 671-687.

[9] Decentralization and 'deconcentration' are stipulated in Romania's Constitution as the two pillars of local public administration. The Framework Law 195/2006 defines exclusive responsibilities of the local public administration, as well as responsibilities shared with the central administration or delegated. The local autonomy was also recognized in the Constitution and was further consolidated through the adoption of the European Local Autonomy Charter in 1997 and during the preparations for the country's 2007 accession to the EU. Government Emergency Ordinance 45/2003 regulates the decentralization of public finances to local public administrations (Dragnea, 2012).

Cohen, W.M. and D.A. Levintal (1990). Absorptive capacity: a new perspective on learning and innovation, Administrative Science Quarterly, 35, 128–153.

De Solla Price, D. (1984). The science/technology relationship, the craft of experimental science and policy for the improvement of high technology innovation, Research Policy, 13, 3-20.

Dosi, G. (1988). Sources, procedures, and microeconomic effects of innovation, Journal of Economic Literature, 16, 1120-1171.

Dragnea, L. (2012). Brief overview of decentralisation, www.decentralizare.ro.

European Commission (2005). Public Procurement for Research and Innovation: Developing procurement practices favourable to R&D and innovation. Expert Group Report. September 2005.

European Commission (2011). Working Document of the Commission Services. Assessment of the 2011 National Reform Programme and Convergence Programme of Romania. SEC(2011) 731 final.

European Commission (2011a). Innovation Union Competitiveness Report 2011.

Faulkner, W. and J. Senker (1994). Making Sense of Diversity: Public-Private Sector Research Linkage in Three Technologies, Research Policy, 23, 673-695.

Freeman, C. (1974). The Economics of Industrial Innovation, Penguin Books: London.

Freeman, C. (1987). Technology Policy and Economic Performance, Pinter: London.

Gibbons, M. and R. Johnston (1974). The Roles of Science in Technological Innovation, Research Policy, 3, 220-242.

Government of Romania (2008). The 2009-2012 Government Programme.

Government of Romania Press Office (2009a). The Government analysed the implementation stage of anti-crisis measures, 1 July 2009.

Government of Romania Press Office (2009b). The Government will support the business sector through a set of economic measures, 26 August 2009.

Hainarosie, L. (2009). What changes will come from the anti-crisis measures in Romania? (in Romanian), Ziare.com, 5 July 2009.

International Monetary Fund (2011). IMF Executive Board Approves New €3.5 Billion Precautionary Stand-By Arrangement for Romania, Completes Seventh and Final Review Under the Current Stand-By Arrangement and Approves €1 Billion Disbursement. Press Release No. 11/101, 25 March, 2011.

Interpress Service (2009). Romania: Pushed by Crisis Into Dubious Borrowing, 6 April 2009.

Klevorick, A. K., C. Levin, R., R. Nelson, S.G. Winter (1995). On the sources and significance of inter-industry differences in technological opportunities, Research Policy, 24, 185-205.

Lundvall, B.-Å. (1992). (ed.) National Systems of Innovation, London: Pinter.

Lungu, L. (2010). Study: Anti-crisis measures on the labour market (in Romanian). Friedrich Ebert Stiftung.

Mansfield, E. (1991). Academic Research and Industrial Innovation, Research Policy, 20: 1-12.

Mediafax (2009). Half of SMEs, seriously or very seriously affected by the financial crisis (in Romanian).

Meyer-Krahmer, F. and U. Schmoch (1998). Science-based technologies: university-industry interactions in four fields, Research Policy, 27, 835-851.

Mowery, D.C. and Nelson, R.R. (1999). Sources of Industrial Leadership. CUP: Cambridge.

Murray, F. (2004). The role of academic inventors in entrepreneurial firms: sharing the laboratory life, Research Policy, 33 (4), 643-659.

Narin, F., Hamilton, K. Olivastro, D. (1997). The linkages between US technology policy and public science, Research Policy, 26: 317-330.

National Agency for Employment (2012). Evolution of the unemployment number in the period 1991-2010.

National Agency for Scientific Reserch (NASR) (2009). Government policies for R&D and innovation in Romania 2009 Report (in Romanian).

National Agency for Scientific Research (NASR) (2010). Government policies for R&D and innovation in Romania. 2010 Report (in Romanian).

National Bank of Romania (2009). Foreign Direct Investment in Romania. Annual statistical research.

National Council of Romanian SMES (2009). Evaluation of the general situation of Romanian SMEs in the first semester 2009. Issue 9 -2009.

National Council of Romanian SMES and Ministry of Industry and Business Environment (2009a). The White Charter of Romanian SMEs.

National Institute of Statistics (2008). Press Release no. 124 of 30 June 2008: Innovation in industry and services in the period 2004-2006.

National Institute of Statistics (2012a). Statistical Yearbook 2010. Labour market.

National Institute of Statistics (2012b). Press Release no. 29 of 8 February 2012: Innovation in industry and services in the period 2008- 2010. Provisional results.

National Institute of Statistics (2012c). Statistical Yearbook 2010. Science, technology and innovation.

National Union of Romanian Employers (2009). 2010, The Second Year of Crisis for SMEs. 27 October 2009.

Nelson, R. (1993) (ed.) National Innovation Systems, Oxford University Press: New York.

Nelson, R. and N. Rosenberg (1994). American universities and technical advance, Research Policy, 23 (3), 323-348.

Newschannel (2009). Romanian Industrialists Union: The effects of the anti-crisis measures are zero (in Romanian), 25 May 2009.

OECD (2009). Policy Responses to the Economic Crisis: Investing in Innovation for Long-Term Growth.

PRO INNO EUROPE (2011). Innovation Union Scoreboard 2010. The Innovation Union's Performance Scoreboard for Research and Innovation. 1 February 2011.

Radio Romania International (2009). The steel industry: state of play in Romania 31/03/09.

Radio Romania International (2009a). The textile industry in Romania 09/06/2009.

Ravoiu, T. (2009). New car sales down by 50% in 2009 (in Romanian), CityNews.ro, 26 June 2009.

Riggs, W. and Von Hippel, E. (1994). Incentives to innovate and the sources of innovation: the case of scientific instruments, Research Policy, 23 (4), 459-469.

Rosenberg, N. (1992). Scientific Instrumentation and University Research, Research Policy, 21, 381-390.

Saegusa, A. (1998). Industrial links still face opposition in Japan's universities, Nature News, 396 (6706).

Salter, A.J. and B.R. Martin (2001). The Economic Benefits of Publicly Funded Basic Research: A Critical Review, Research Policy, 30 (3), 509–532.

Santoro, M.D. and A.K. Chakrabarti (2002). Firm size and technology centrality in university-industry interactions, Research Policy, 31 (7), 1163-1180.

Schumpeter, J.A. (1934). The Theory of Economic Development, Harvard University Press: Cambridge, MA.

Schumpeter J. A. (1942). Capitalism, Socialism and Democracy, Harper: New York.
Tanase, N. (2011). National Technology Transfer and Innovation Network ReNITT, Presentation at the Transylvanian SMEs' Open Day. 7 July 2011.

World Bank (2011). Romania Research, Development and Innovation Sector Functional Review. Final Report. May 31, 2011.

TRIANGULATION OF THE TRIPLE HELIX: A CONCEPTUAL FRAMEWORK FOR REGIONAL COMPETITIVENESS FOCUSED ON INNOVATION AND LOCAL ENTREPRENEURSHIP

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Abstract
Society seems more complex molecular biology itself, depleting the model of the double helix so far valid model to explain the DNA – Desoxiribo Nucleid Acid, essential for understanding the structure and activity of the DNA and heredity. The innovation of the triple helix is now required to explain the relations between the academy, industry and government. Innovation has become the decisive challenge for global competitiveness. The advantages associated to entrepreneurship are unquestionable from the point of view of regions development, taking as a strong driver of employment and wealth creation. The Academy leading role is based on human capital, through its enhancement of skills, or by knowledge transfer and technology, sometimes coated with an entrepreneurial dynamics resulting in spin-off's and start-up's family-oriented. The competitiveness of firms determines the flows of income and employment regions. The government is a key dimension to stable interactions between the spheres of the system's main roles in the economic and social networks to ensure cooperation, partnership and institutional support. In this context, this research aims to develop a conceptual model of triangulation of the triple helix explaining and understanding the importance of innovation and entrepreneurship within the dynamics interaction of the triple helix as a factor of competitiveness and regional development.

Keywords: Innovation, Entrepreneurship, Competitiveness, Regional Development, Triple Helix

1. INTRODUCTION

The existence of a strong national diamond cluster is crucial to an economy attaining competitive advantage (Porter & Stern, 2001; Budd & Hirmis, 2004), capable of putting those investment projects into practice able to boost competition between local rivals whilst not overlooking the need to preempt increasingly sophisticated and demanding client needs, and to ensure the capacities of local suppliers and industrial clusters. This framework furthermore needs to guarantee factors including market entrance requirements, scientific and technical quality and human resource management as well as sources of risk capital (Porter & Stern, 2001).

In recent decades, cooperation and networking have become the guiding paradigms for explaining and encouraging regional development. Today, regional networks increasingly have to cope with the competition posed by other networks at the global level (Semlinger, 2008). We should therefore ascertain the actual capacities of local companies to sell their products in external markets, the value of such sales and their productive levels of efficiency while also taking into account the incorporation of local resources and including both human and capital dimensions (Turok, 2004).

Schumpeter, in his 1911 work "The Theory of Economic Development: an Inquiry into Profits, Capital, Credit, Interest and the Business Cycle", conceptually defined the "entrepreneur as innovator" as a key factor in fostering economic development (Wong et al., 2005). Innovative activities undertaken by entrepreneurs drive a "process of creative destruction" and triggering disturbances that end up rebalancing the economic system, creating opportunities and wealth. From Schumpeter's (1942) perspective, entrepreneurship has taken on a steadily more important role within the overall framework of economic growth (Wong et al., 2005; Kim et al., 2011). Hence, competition correspondingly derives from feeding this entrepreneurial spirit as a driving force in modern economies and the background against which organisations engage in struggles for survival from a perspective of necessarily efficient operational processes (Nijkamp, 2003). Entrepreneurship and innovation have thus been defended by a range of different specialists as fundamental factors for bringing about economic development (Porter & Stern, 2001; Wong, 2005; Nordqvist & Melin, 2010).

Overall, the general theories apply many times in different areas, from natural areas to different disciplinary domains. The theory applies DNA (Desoxiribo Nucleid Acid) from molecular biology, agriculture, environment, human health, animal health, and etc. The generality of the application of a theory requires an interdisciplinary training and research organizations able to highlight promising areas of innovation and knowledge generation and technology, requiring an interdisciplinary division of labour that may be conferred by university and enterprise (Viale & Etzkowitz, 2010).

The fallout and pressures of the global financial crisis further heighten the importance of reflecting on regional development (Potts, 2010). The productive competitiveness of companies and the stability of relationships in terms of policy decision making relating to areas such as the transfer of knowledge and technology have been included within the Triple Helix framework: University – Industry – Government (Etzkowitz & Leydesdorff, 2000; Etzkowitz, 2003a; Etzkowitz, 2003b; Cooke & Leydesdorff, 2006), and proving fundamental to boosting regional innovation systems (Etzkowitz &Dzisah, 2008; Smith & Bachi-Sem, 2010; Galindo et al., 2011; Halei et al., 2011).

Through recourse to the bibliographic research method, based upon reviewing the deep and extensive range of literature dealing with innovation and entrepreneurship, competitiveness and regional development, in addition to the triple helix structure, this article sets out and develops a conceptual model triangulating the triple helix. This thereby explains and enables a better understanding of the importance of innovation and entrepreneurship within the dynamic interactions of the triple helix as a factor in regional competitiveness and development.
From the structural perspective, the article is broken down into eight core sections, respectively: the introduction, innovation and competitiveness; competitiveness and regional development; innovation and entrepreneurship, the emergence of the triple helix system; the triple helix and its dynamics; building a conceptual model for regional competitiveness; before closing with some final considerations.

2. INNOVATION AND COMPETITIVENESS

Competitiveness is defined by Schwab (2010) as a set of institutions, policies and factors combining to determine the level of productivity of an economy and its corresponding capacity to generate wealth and returns on investments and determining the potential for economic growth. Its entire structure rests upon twelve foundation stones: institutions, infrastructures, the surrounding macroeconomic environment, healthcare and primary education, higher education and training, the efficiency of goods markets, the efficiency of the labour market, financial market development, the technological level of development, the market scale, and the level of business and innovation sophistication.

Innovation is now a decisive challenge for global competitiveness; to achieve success companies have to know how to deal with the issues deriving, leveraging the strengths of their location for the creation and commercialisation of new products and services. In advanced economies, producing standardized products, with recourse to standard methods and processes, is now insufficient to attain competitive advantage. Companies need the skills and capacities to innovate in the global marketplace, designing, inventing, producing and selling a flow of new products, advancing the frontiers of their state of the art technology and evolving faster than their rivals. According to Porter and Stern (2001), this is characterised by capacities to, within the terms of free and fair markets, produce goods and services able to meet the needs prevailing in the marketplace, maintaining and increasing the flow of earnings to their population into the long term (Budd & Hirmisf, 2004). Furthermore, two of the leading reasons driving this strengthening of competitive pressures are the growing international mobility of capital and the openness of markets in conjunction with phenomena deriving from globalisation. Economies have strengthened their interdependence through raising levels of both exports and imports, boosting foreign direct investment, removing barriers to trade and the transnational organisation negotiating powers over the transport sector (Turok, 2004).

The pressures of a global financial crisis, an ageing population, the decline in stocks of natural resources and the prospects of long term scarcity and the impact of climate change represent just a beginning of the questions that need taking into consideration within the scope of regional development (Potts, 2010). Sustainability has to be approached within a perspective combining the environmental, economic and social dimensions. This thus implies that organisations, in order to reflect the current extent of the competitive advantage concept, need not only to take into account traditional financial aspects but also environmental and social dimensions and hence including factors related to climate change, global warming, air, land and water pollution, the destruction of the ozone layer and in addition to healthcare and safety related issues, social wellbeing, fair employment opportunities, charitable institutions, cultural sensitivities and the standards now demanded of organisational behaviour (Gopalakrishnan et al., 2012). The overwhelming majority of the literature published on the link between ethics and entrepreneurship focuses on the micro level and the actions undertaken by the entrepreneur facing dilemmas that may prove particularly relevant for configuring the new venture or business and thereby having to respond to a series of issues about ethics within the context of entrepreneurial activities. These include (Harris et al., 2009): how do entrepreneurs differ from non-entrepreneurs in relation to ethics? In what way do entrepreneurs actually take ethical decisions? What ethical dilemmas emerge out of entrepreneurial related activities? In what way does technological innovation impact on entrepreneurial ethics? In what way do ethical organisational behaviours develop within the contexts of new companies? What distinguishes ethical questions in more social or non-profit based organisations?

From the perspective of Porter and Stern (2001), there is a set of factors transversal to the economy that support innovation and including: the human and financial resources allocated to scientific and technological advances, the level of technological sophistication, the public policies affecting innovation related activities, intellectual property protection, fiscal incentives for innovation, and enacting and effectively implementing antitrust and abuse of power legislation. In sum, the prevailing framework needs to encourage innovation rooted in market competition and the openness of the economy to trade and investment. While common innovation infrastructures define the prevailing conditions for innovation, companies interconnected in clusters introduce and commercialise innovations in the marketplace and including new technologies.

To describe the innovation context, Porter and Stern (2001) put forward a national framework for innovation capacities, and specifying innovation infrastructures and the clusters specific to the innovation environment (Figure 1).

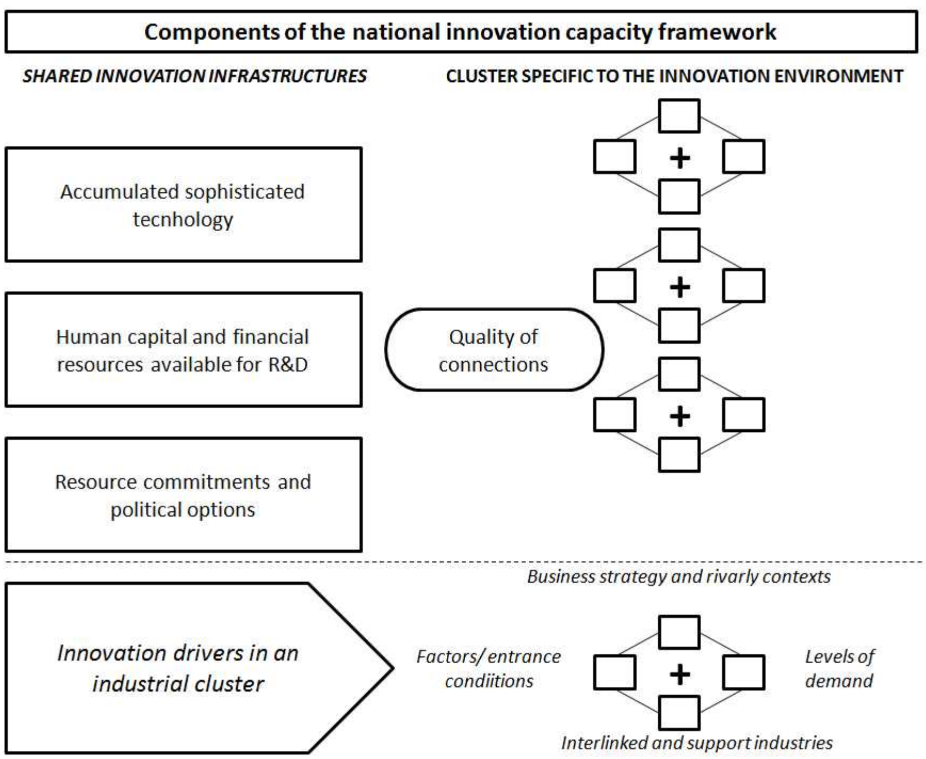

Figure 1 –innovation capacity model

Source: Adapted from Porter & Stern, 2001: 29.

The relationship between shared innovation infrastructures and industrial clusters is reciprocal: strong clusters foster the shared infrastructures while also leveraging the benefits resulting. A broad grouping of formal and informal organisations, engaged in cooperation and networking, may position themselves between two fields, within the scope of which higher education stands out as a bridge between technologies and companies (Porter & Stern, 2001). From the corporate social responsibility point of view of organisations, we need to grasp the social dimensions to competitive business environments (Porter & Kramer, 2006).

Focusing on the “Comparative Advantage of Nations” theory referenced by Porter & Kramer (2006), listed the factors influencing competitive advantage and contained in the “diamond” model described as: the strategic context for companies and their rivals (the local scenarios encouraging investment and innovation through robust competition between locally based rivals), the terms of demand (sophisticated and demanding local clients and their needs); related and support industries (the presence of local suppliers able to serve related companies, the presence of clusters rather than isolated industries), entrance factors and conditions (highly qualified human capital, especially in the scientific, technical and management fields, good basic research infrastructures at universities, high quality communication infrastructures and an ample supply of risk capital.

From the perspective of regional development, the competitive production of companies determines the levels of earnings and employability at the level of the regional business environment while demand is determined according to relative costs (Budd & Hirmisf, 2004). There is an additional set of political entities, industrial organisations and academic institutions that work in conjunction to improve and enhance local conditions for innovation and the organisation of regional processes fostering safe and secure surroundings for developing and implementing innovation based strategies – the triple helix (Etzkowitz, 2008).

3. COMPETITIVENESS AND REGIONAL DEVELOPMENT

In its most basic facets, regional (and urban) competitiveness may be defined as the success regions and cities attain in ongoing mutual competition that occurs in different forms, whether from the point of view of actions and results in national and international markets or whether as regards the capacity to attract financial and human capital resources (Audretsch et al., 2011). The term “Region” traces its origins to the Latin “*Regio*”, that in turn derives from “*regere*”, meaning “to govern”. In the field of regional development, the term “Region” has been applied to define the governance inherent to policy decision making on issues relating to support for economic development processes. Administratively, “Region” is a territorial division in effect in Portugal’s case, for example (Cooke & Leydesdorff, 2006). The idea of regional competitiveness, according to Audretsch et al. (2011), and reinforcing the vision set down by the European Commission in 1999, should incorporate the fact that despite having both highly competitive and non-competitive companies in each region, there are shared characteristics within any particular region impacting on the respective levels of competitiveness attained by all companies located within its extent.

According to the logics underpinning regional development, the predominance of the relationships between universities – industry – government (state or municipal) and specific local activities (for example, local technology transfers, the development of human capital and networking), in conjunction, determine better overall results (Smith & Bagchi-Sen, 2010).

Development may correspondingly be broken down into exogenous development and endogenous development. Exogenous based factors derive from the respective importance of importing technology and foreign direct investment, sometimes bound up with natural resource extraction. Endogenous development, in turn, is based on boosting local stocks of intellectual capital and support to institutions such as higher education facilities, research centres, company incubators and scientific parks with the purpose of aggregating the value of resources ranging from the agricultural sector through to all the different fields of the economy.

Innovation is now generally accepted as a critical parameter of human intelligence and cognitive capacities (Galindo et al., 2011). The regional innovation concept is based on an interactive set of private and public interests, formal institutions and other entities that operate in accordance with organisational and institutional agreements and establish relationships leading to the generation and dissemination of knowledge. The concept involves analysing the existence of actors (institutions, groups, universities, industries, …) and regional competences as well as the ongoing inter-network interactions engaged with innovation related purposes within the scope of the overall objective of providing the local and state authorities with tools for defining policies able to boost real competitiveness (Huahai et al., 2011).

Representing the foundation stone of the triple helix model, intellectual resources are, in principle, continually renewable, subject to strengthening and deepening, and therefore stand out as the single best source for regional development (Etzkowitz & Dzisah, 2008). The theory of economic growth has undergone an impressive rebirth in recent times, particularly in terms of the publication of studies on the new economic geography based on endogenous growth theories and serving to heighten global interest in the driving forces and socioeconomic impacts of innovation and entrepreneurship.

In industry, Lundberg and Andresen (2011) testify to how company behaviour and performance does not only depend on endogenous factors but also on their relational networks. Cooperative relationships designed to bring about research and development constitutes a proven explanatory factor for differences observed in levels of innovation and not only between companies but also between regions. In the academic sphere, there is a vast body of literature on the economic impact of universities, whether at the regional level or the national level, and establishing the contribution made by research and development towards gross domestic product. According to some authors, these studies need to advance still further and integrate the dynamic impact of universities on regions as regards all activities ongoing, including, but not exclusively, research and development (Martin, 1998).

Consistent to this interpretation, a series of academic studies has recognised that cooperation between the three institutional spheres (university – industry – state) is fundamental to improving regional and national innovation systems (Etzkowitz, 2003a; Etzkowitz, 2003b; Etzkowitz & Leydesdorff, 2000; Cooke & Leydesdorff, 2006; Leydesdorff & Meyer, 2006; Etzkowitz & Dzisah, 2008; Smith & Bagchi-Sen, 2010; Galindo et al., 2011; Huahai et al., 2011).

4. INNOVATION AND ENTREPRENEURSHIP

Ever since the founding of economic history (Adam Smith, Ricardo), entrepreneurship has been identified as a critical factor to attaining and maintaining successful economic development. In the 20th century, Alfred Marshall, within the context of growth in capitalist economies, directly defined the notion of entrepreneurial competition (Nijkamp, 2003).

Entrepreneurship stands at the centre of economic and industrial policies and incorporates both the founding of new businesses and the development of new business opportunities in already existing firms. Entrepreneurship is, in accordance with the definition set out under the auspices of the GEM (Global Entrepreneurship Monitor) project, an attempt to launch a new business or new initiative, increasing current employment levels and either a new business organisation or the expansion of an already existing firm (GEM, 2007).

Regional policies aim to nurture spin-off companies as an important mechanism for deepening university-industry relationships and generating employment and wealth. Science parks represent an organisational innovation that spread globally throughout the latter half of the 20th century, fostering the emergence of technology-based initiatives. The presence of company incubators may also enhance the opportunities for networking, providing tenants (companies) with the appropriate technical and other support infrastructures and services (Salvador, 2010).

Experiences in the higher education system may establish the framework for building up personal networks, and, to the extent these networks are localized, may drive the creation of social capital incorporated into the core of local entrepreneurial activities (Baltzopoulos & Broström, 2011).

Entrepreneurship represents a high risk dynamic and a highly elevated binomial level of effort – reward, where an entrepreneur's success is very often arising out of a mixture of luck, a good idea, the possession of the right information, combined with competitive decision making processes. The relevant information should be integrated into a business-plan based project, involving analysis of the sources of opportunity and other research outputs dealing with the knowledge underpinning the new business or entrepreneur venture, for example, digitalised databases and centres of local economic development (Kirkwood, 2010).

In the family-based entrepreneurial perspective, Nordqvist and Melin (2010) define three themes for their familiar entrepreneurial model: Actor, Activity and Attitude (the three A´s). The actor refers to the family as the entity engaged in business related activities and not limited only to the social or organisational context. Activity means a specific action or process undertaken by the family, endowed with entrepreneurial significance within the domestic environment of the family itself, the family firm or, in a broader context, within the framework of developing the respective region. Attitude reflects the mentality and the approach of the family to processes and dynamics of the business.

The advantages associated with entrepreneurship prove unquestionable from the GEM perspective: the creation of new companies resulting from investment in the heart of the local economy, creating new jobs, enhancing competitiveness and developing the tools serving innovative businesses. Entrepreneurship thus becomes a core driver of employment and economic growth and a key factor in sustaining competitive and globalised market economies (Kelley et al., 2011).

Nijkamp (2003) defends that one of the key drivers of change leading to a new balance is centred around innovation as such is capable of advancing existing standards of productivity through serving as a creative *"modus operandi"* for entrepreneurs and enabling processes of economic growth. Companies seek out discontinuous innovation and thereby tend to build up partnerships and in some instances transferring units to science parks to ensure an even closer relationship with academic research groups (Etzkowitz, 2008).

In the GEM conceptual model, the "entrepreneurial opportunities" are bound up both with the existence and capturing of market opportunities and the evaluation of the "entrepreneurial capacity", the potential, the experience and the motivation of individuals to launch businesses, such as the necessary skills leading to the successful implementation of entrepreneurial initiatives. Additionally, the opportunities and capacities determine the entrepreneurial activity (Early-Stage), resulting in a rate of entrepreneurial activity - REA (Rate of Early-Stage Entrepreneurial Activity) with innovation representing a significant share of the factors contributing towards "economic growth" (Kelley et al., 2011).

The GEM model takes into account the social, cultural and political context of the surrounding environment, subdividing the social conditions into two branches – firstly, the economic factors required for developing entrepreneurial activities: "structural conditions" – including the level of openness to the market, the government's role, management, technology, R&D, the physical infrastructures, the financial and labour markets in addition to all the social and legal institutions. The second branch covers the "structural entrepreneurial conditions" and including factors such as financial support, government policies and programs, education and training levels, transfer of R&D results, commercial and professional infrastructures, openness to internal markets, access to physical infrastructures, social and cultural norms and the protection granted to industrial property rights. Driving the growth of companies and the development of entrepreneurial opportunities, skills and capacities, through the creation of employment and technical innovation ensures both regional and national economic growth (GEM., 2007; Kelley et al., 2011). The model furthermore takes into consideration how economic prosperity to a large extent depends on the dynamics ongoing across business sectors, irrespective of the stage of development while not overlooking the sheer variability in entrepreneur profiles (Kelley et al., 2011).

5. THE EMERGENCE OF THE TRIPLE HELIX SYSTEM

Contemporary relationships deriving from interactions ongoing between the spheres of university and industry are resulting in a third hybrid current whether out of common interests in basic research, partnership projects between industry and higher education institutions as well as through the joint establishment of research and development programs making recourse to multiple sources of financing (Etzkowitz, 2008).

Various evolutionary stages need accounting for in terms of the many interactions between the triple helix spheres. Out of what has been entitled the scientific-technological revolution, before which the absolute dominance of the government sphere prevailed over those of universities and industry, especially since the collapse of the most extreme of such regimes (those found in the now formerly communist countries), there arose added difficulties in justifying the involvement of the state beyond certain core activities and factors of social well-being. Within the current context, the analysts and political decision makers turned to the concept of innovation, a new conceptual framework providing a new justification of the role of government in the economy and, when adopting the logics driving interactions within the triple helix concept, thereby enabling and encouraging the emergence of new hybrid organisations (Etzkowitz, 2003a; Etzkowitz, 2008).

Theories falling under the scope of the Triple Helix approach provide some evidence that universities may perform a heightened role in innovation within the context of knowledge based societies (Etzkowitz, 2003a; Etzkowitz, 2003b; Etzkowitz & Leydesdorff, 2000; Etzkowitz & Dzisah, 2008; Leydesdorff & Meyer, 2006). While the knowledge based systems may be considered inherently a result of the different mechanisms of social coordination – markets, the production and the management of knowledge (public and private), the relationships ongoing in the triple helix model prove heuristic to the study of the complex dynamics taking place within the framework of institutional networks involving the respective actors: university – industry – government (Leydesdorff & Meyer, 2006).

The Triple Helix model centres on interactions between universities1 – industry – government as the key to improving the conditions required for the innovations at the heart of knowledge based societies. Industry becomes the dynamic to the triple helix, taking on the role of production while the government is attributed responsibility for overseeing the contractual relationships capable of guaranteeing interactions and stable relationships of exchange with universities allocated the role of producing new knowledge and technology. This represents the principle of production underlying knowledge based economies (Etzkowitz, 2003a).

The higher education system has become entrepreneurial broadly through internal dynamics while also driven by external contacts to private sector firms within the scope of research contracts and transfers of knowledge and technology (Etzkowitz, 2003b). Given such progress in understanding the transformations taking place in economic relationships, the priority moves onto clarifying the core features of interest and the perspectives they encapsulate (Cooke & Leydesdorff, 2006).

According to Etzkowitz (2003a), the triple helix dynamic is based upon the range of agreements and partnership networks occurring between the respective institutional triple helix spheres and actually proving able to better advance new sources of innovation in comparison with any isolated initiative designed to generate such results. Correspondingly, attention is drawn to incubators and science parks in conjunction with the networks established between the different triple helix partners driven by a shared desire for research based cooperation and the implementation of new entrepreneurial projects.

Adopting policies able to drive convergence and synergies between the higher education system and companies leverages comparative advantages for some universities thereby enabling teaching to be complemented by research, which would suggest that this support variable, where not accelerating, at least fosters new technological and other developments (Yusuf & Nabeshima, 2007).

The interaction between linear dynamics and reversible dynamics results in an interactive innovation model: the linear model of knowledge transfers within which technology generated in higher education units is transferred out through intellectual property licensing services or training provided to companies in the incubator phase, for example. In contrast, the reversible linear model emerges out of the industrial and social problems that supply new and evolving grounds for new research programs (Etzkowitz, 2003a).

The triple helix model of development is inherently rooted in the transition from an industrial society to a knowledge based society within the scope of which universities play an increasingly important role in innovation and development all the while technology transfers turn into processes tending to shrink in scale with steadily more flexible organisations tending to prevail. We should highlight the emergence of adaptable and multipurpose knowledge in fields such as biotechnology and computer sciences that manages to be simultaneously theoretical and practical and eligible for patenting and publication (Etzkowitz & Dzisah, 2008).

The "capitalisation" of knowledge drives financial capital into acquiring ever greater inputs from knowledge through invention, the sharing of new risks and mechanisms for attracting investment as is the case with risk capital companies. Capital is now established and built up according to new dimensions: financial, social, cultural and intellectual. Newly capitalised companies are based on social interaction, within which human, social and intellectual capital are redefined within a perspective of more intense interaction and cooperation between the university, industry and government helix components (Etzkowitz, 2003a).

Aligning the triple helix system to the regional competitiveness factor and the innovative activities of local companies, based upon knowledge and high technology, proves the point of departure for a better theoretical understanding (Galindo et al., 2011).

Globalisation has become decentralised and takes place through regional networks whether of universities or of multinational companies and organisations. Countries and regions experiencing development gain the opportunity to make rapid progress when able to root their development strategies in building up niche sources of knowledge. Support from the political and local economic frameworks need to ensure that principles of equity and transparency establish the foundations for swift growth within a stable prevailing environment (Etzkowitz, 2003a).

As an analytical model, the triple helix also incorporates descriptions of the sheer variety of institutional agreements and political decision making processes in effect. In practice, this represents an explanation of its own dynamic and producing answers to questions such as (Etzkowitz & Leydesdorff, 2000): which units are brought into operation in the founding of an innovation system?, and just how can such systems be specified?

6. THE TRIPLE HELIX AND ITS DYNAMICS

The evolution of innovation systems and the current dispute over which path is most appropriate for university – industry relationships effects the different institutional agreements in terms of the overall university – industry – government relationships (Etzkowitz & Leydesdorff, 2000).
State – industry – university relationships have been subject to various configurations over the course of history (figure 2).

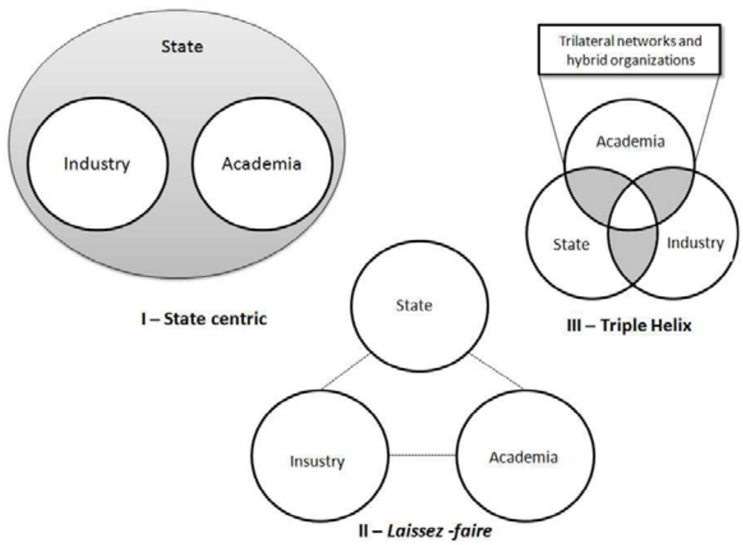

Figure 2 – From “state-centric” to the *laissez-faire* and triple helix models

Source: Etzkowitz (2003:302)

In the first configuration (I – State-centric), the reach of the state extends over both industry and the higher education system and guiding and structuring their mutual relationships. This model was implemented to an extreme extent in the Soviet Union and the formerly Socialist countries of Eastern Europe and remains in effect in far weaker versions in some European countries such as Norway (Etzkowitz & Leydesdorff, 2000).

The second model of political decision making (II – *Laissez faire*) involves the separation of the three institutional spheres: university – industry – government through the intermediation of strong barriers with only modest mutual interactions and highlighting the existence of autonomous movement in the direction of a new global model for managing knowledge and technology (Etzkowitz, 2003a; Etzkowitz & Leydesdorff, 2000).

The evolutionary perspective of model (III – Triple Helix) facilitates the generation of a knowledge based infrastructure overlying the different institutional spheres, where each takes on the role of the other within the framework of an emerging tripartite interface between hybrid organisations (Etzkowitz & Leydesdorff, 2000).

Given contemporary societies are no longer coordinated by some central power, a “Rome” or a “Moscow”, but which function in terms of interactions through diverse codified communications, the current triple helix model is open to the presentation of proposals extending the model to four or more helixes (and potentially incorporating an alphabet of twenty or more helixes). This would expand its potential coverage to new communication variables that might be power, truth, trust, emotional intelligence or other interfaces relating to intellectual property protection rights (Leydesdorff, 2011). Reinforcing this thesis of expanding the triple helix model, MacGregor et al. (2010) defend how the triple helix innovation process may serve as the core foundational model for evolutionary progression to a quadruple helix that totally integrates the spheres and where the overlapping roles serve to create or discover new knowledge, technologies or products and services from a perspective of meeting a social need. Making references to studies undertaken by different authors, Leydesdorff (2011) highlights the case of Japan in the 1990s in which the addition of an extra, fourth, helix was necessary as in addition to the relationships ongoing between university – industry – government, internationalisation also played an important role in the economy just as the emergence of the Internet deepened and strengthened globalisation through the provision of a new means of professional communication.

Referred to by some researchers within the scope of a fourth helix-pillar are independent organisations, without any profit motive and combining public and private financing. They seek to play a facilitating role between the three traditional pillars (academy – industry – government), channelling public and private investment while simultaneously planning the division of costs associated with research and development (R&D) programs, sharing infrastructures and supplying technical products and services. They furthermore aim to establish leadership networks in industry and university, set up R&D focused partnerships, facilitate the pathway to excellence through the attraction, development and retention of the highly qualified individuals (MacGregor et al., 2010), necessary to regional competitiveness and development (Audretsch et al., 2011).

6.1. THE ACTIVE UNIVERSITY ROLE

While universities produce consumer goods, such as entertainment and culture, their core purpose consists of strengthening human capital, raising and refining the skills and capacities of their graduates, fostering talents, curiosity, imagination and creativity (Siegfried et al., 2007).

In the study published by McAdam et al. (2011), on the development of the university's role in the transfer of technology to interested parties at the regional level, three potential means of aggregating value for regional development are put forward: the regional benefits of universities (population growth, job opportunities, increasing spin-offs and other costs), the benefits implicitly deriving from growth in the "knowledge economy", and the response capacity through the supply of flexible and innovative solutions to the front-line of an economy undergoing rapid mutation within a concept of regions acquiring knowledge and including universities. Furthering this analysis, Dinapoli (2011) highlights how higher education institutions act as catalysers of economic growth and serve as the fuel to drive new ideas and technologies through building up a qualified workforce, establishing partnerships with private sector entities and investors. The university may also help reposition regions within the framework of knowledge economies, fostering their development through the conversion of research outputs into new products and businesses, generating employment and wealth (Dinapoli & McAdam, 2011).

In the analysis produced by Bathel et al. (2010), there emerge differences in the descriptions of spinoff related phenomena, building on and clarifying Etzkowitz et al. (2000) as regards the significance of academic spin-offs and entrepreneurial start-ups as a mechanism for transferring technology leading to regional economic competitiveness and development.

Confirming this perspective as to the economic impact of higher education at the regional level, Dinapoli (2011) points to a July 2011 New York state public information report on the importance of higher education to the region. That level of education is openly accepted as a major industry to the region, employing over 265,000 people, paying out over $13 billion in salaries in 2009 and with a total number in excess of 1.2 million students enrolled, of which around a fifth are registered on postgraduate programs (including law, the medical sciences, theology, …).

Higher education performs an important role in revitalising regional economies especially when taking into account all the related expenditure on and off academic campuses whether on personnel, investment in research and new projects, medical installations, arts and cultural events, hosting conferences and congresses, equipment and other infrastructures as well as food and beverage outlets. Such advantages come in addition to all the value of the skills and competences learned and enabling students to apply such gains to leverage their own lives and highlight the importance of geographic proximity to knowledge transfer processes (Bramwell, 2008; Garrido-Yserte & Gallo-Rivera, 2008; Eom & Lee, 2010; Dinapoli, 2011). Proximity as a source of research proves important in determining success in transferring the knowledge generated in laboratories to businesses and enabling their deployment in commercial development and the adoption and spread of innovation processes (Bramwell & Wolfe, 2008).

Referring to the entrepreneurial initiatives emerging out of university environments, Arroyo-Vázquez et al. (2009) emphasise the need for a creative and innovative stance in order to generate integrated models able to reach out to the different interested parties and their respective objectives, transferring knowledge and enhancing company growth within the context of entrepreneurial universities. In contrast to the classical concept of university and its social contribution, this entrepreneurial university approach constitutes a powerful development concept proposing a flexible organisation that interacts with its social and economic environment, adapting to change, seeking out additional sources of resources whether for researching or transferring technology and leveraging its commercial value, not only managing all these activities entrepreneurially, but also establishing relationships with a varied range of interested parties.

Entrepreneurial universities represent independent higher education institutions, free of state or industrial control, displaying a high degree of autonomy in defining their own strategies and missions and participating as an equal in other institutional spheres, in formulating joint projects for economic and social development, particularly at the regional level. Given that not all universities are able to attain such entrepreneurial profiles (whether due to a lack of interest in commercialising knowledge and discoveries or participating in initiatives designed to improve social welfare), the entrepreneurial university model has been found to expand especially through engineering activities and managing activities undertaken out of social objectives (Etzkowitz, 2008).
According to Van Looy et al. (2011), the logic of "university ventures" is tightly bound up with the existence of shortcomings in the innovation market.

There are two trends shaping the framework of contemporary developments in relationships between university and industry: interests in basic research financed by research entities and councils and industrial projects, which universities are invited to participate in with a third hybrid current emerging with the formulation of joint research programs making recourse to multiple sources of financing (Etzkowitz, 2008).

7. CONSTRUCTING A CONCEPTUAL MODEL FOR REGIONAL COMPETITIVENESS

Contemporary society turns out to be more complex than even molecular biology and exhausting the scope of the double helix model for explaining inter-related phenomena. However, the literature on the emergence of the triple helix model unanimously states the need for university – industry – government interactions to become the key to innovation in knowledge based societies (Etzkowitz, 2003a).

The triple helix development model fundamentally rests on the paradigm change from an industrial society to a knowledge based society. This correspondingly attributes an important role to innovation and development through their roles in transferring knowledge and technology (Etzkowitz, 2003a; Etzkowitz, 2003b; Etzkowitz & Dzisah, 2008; Galindo et al., 2011); reflected in the various different institutional agreements in terms of the relationship between spheres and the transformations taking place in terms of the economic relationships in effect (Etzkowitz & Leydesdorff, 2000; Cooke & Leydesdorff, 2006).

Given the changes in societies that have shaken off domination by a central instance, some authors have felt the case for presenting possible new alternative model scales with four or more helixes based on new variables (Leydesdorff, 2011; MacGregor et al., 2010) fostering regional competitiveness and development (Audretsch et al., 2011).

Appointing innovation as the decisive challenge to overall levels of competitiveness, Porter and Stern (2001) refer to a model framework portraying necessary innovative capacities and reporting on the specific infrastructures and clusters present in innovative environments.

Backing up this perspective on how regional competitiveness and development determine the productive capacity of companies and regional levels of income and employability (Budd & Hirmisf, 2004), other authors highlight the predominance of relationships between university – industry – government (state, regional or local) and specific local activities in determining the best business results and outcomes (Smith & Bagchi-Sem, 2010). A set of political entities, industrial organisations and academic institutions jointly work together within the overall objective of boosting the conditions for innovation and organisation able to drive regional development processes (Etzkowitz, 2008).

Beyond exogenous developments, brought about by the arrival of technology and foreign direct investment, endogenous resources now need new standards of competitive improvement. The increasing levels of local intellectual capital and institutional support (Etzkowitz & Dzisah, 2008) enable the development of an interactive group of private and public interests, acting through a network of organisational and institutional agreements and fostering the dissemination of knowledge, technologies and regionally located innovation skills and capacities (Huahai et al., 2011).

Irrespective of financial pressures within the current context of global crisis, in cases compounded by demographic ageing or alternatively by a drop in the level of natural resource reserves as factors constraining regional development levels (Potts, 2010), in their model for building up national innovation capacities, Porter and Stern (2001) stress the need for networking by both formal and informal organisations, displaying a structured set of drivers within the context of innovation oriented clusters.

From the Global Entrepreneurship Monitor perspective, launching new companies results in investment and job creation enhancing greater competitiveness and development and correspondingly boosting local economic growth (Kelley et al., 2011).

The definition and explanations of regional competitive advantage extend far beyond any production focused concerns. The quality and abilities of the labour force (human capital); the extension, depth and focus of social and institutional networks (social/institutional capital), the range and quality of installations as well as cultural assets (cultural capital), the presence of a creative and innovative class (knowledge/creative capital), and the quality of infrastructural policies and results (infrastructural capital) are all deemed to be critical factors in supporting and determining regional economic outcomes (Kitson et al., 2004).

We now proceed, following the literature review above, with setting out a new conceptual model (Figure 3), based upon the Triple Helix model, defended by a vast range of authors (Cooke & Leydesdorff, 2006; Etzkowitz, 2003a; Etzkowitz, 2003b; Etzkowitz & Leydesdorff, 2000; Etzkowitz & Dzisah, 2008; Galindo et al., 2011), focused on innovation and entrepreneurship as critical factors to regional competitiveness and development through their capacities to stimulate new investment and job creation, thus driving economies to attain new standards of competition (Kelley et al., 2011).

Building on the work of Porter and Stern (2001) and the need for inter-organisational networks, Huahai et al. (2011) stress the need for the interactive engagement of public and private interests based on the dissemination of knowledge and technology within the context of a new regional innovation clusters.

The triple helix spheres, while set out contextualised within their external environment (the political, economic, social, cultural and technological contexts), as dealt with in the Global Entrepreneurship Monitor report in Kelley et al., (2011), describe the dynamic and interactive movements of partnerships, supported by and in the format of cooperative networks striving to boost competitiveness, a perspective also defended by Huahai et al. (2011).

As proposed by Kitson et al. (2004), regional competitive advantage furthermore inherently requires articulated involvement and action across a multi-level scenario, within which feature the different variants of capital. The model put forward foresees articulated and dynamic interactions between teaching and research, R&D, human and creative capital; productive capital, financial capital, as well as political options. Supporting the Kelley et al. (2011) perspective, these capital factors combine to establish partnership and cooperation networks enabling the pro-innovation and entrepreneurial environment necessary to attracting investment and providing employment through the creation and maintenance of jobs (enhanced through the valuing of personal competences). Furthermore, increased business sophistication similarly confers a higher level of regional competitiveness through the provision of non-standardised goods and services of greater added value in the marketplace.
Seeking to aid in describing and clarifying the dynamics underlying regional competitiveness and development, the

Triple Helix Triangulation model features a new model leveraging the dynamics present in the triple helix focusing on local innovation and entrepreneurship as catalysers of development and a region's ability to compete globally based upon networked management and rooted in the three pillars of sustainability: environmental, economic and social (Figure 4).

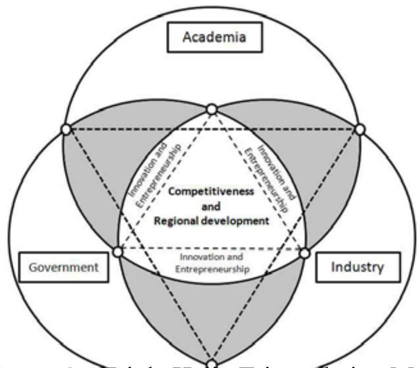

Figure 4 – Triple Helix Triangulation Model

The Triple Helix Triangulation (THT) model is structured around the interactive relationships between the three institutional spheres (university – industry – government) referred to by various authors (Etzkowitz, 2003a; Etzkowitz & Leydesdorff, 2000; Etzkowitz & Dzisah, 2008); Huahai et al., 2011; Leydesdorff, 2011; Leydesdorff & Meyer, 2006; Smith & Bagchi-Sem, 2010), as key institutions to the knowledge that itself is the key to production that becomes the key to stable interactions.

Entrepreneurial dynamics constitute an important mechanism to regional development, whether deriving from academic spin-offs, rendered support by science and technology parks and incubators, as defended by Salvador (2010); or resulting from the founding and expansion of family based companies, as proposed by Nordqvist Melin (2010) and, in either case, resulting in locally produced employment and wealth.

According to Gopalakrishnan et al. (2012), sustainability should also be perceived of within a threedimensional approach: environmental, economic-financial and social, thereby boosting the competitive advantage of regions. Harris et al. (2009) point out how ethics and entrepreneurship remain inherently bound up and of particular relevance within the framework of entrepreneurial activities and regional development.

8. FINAL CONSIDERATIONS

This study aims to put forward a conceptual model displaying a dynamic and interactive triple helix framework able to clarify the importance of innovation and entrepreneurship as factors of competitiveness and regional development. Entrepreneurship is defined in the literature as a high risk dynamic and with an especially high binomial level of effort-reward.

Companies need to be able to innovate in the global marketplace, designing, producing and commercialising new products and evolving faster than their rivals. The development of regions may correspondingly be segregated into exogenous development and endogenous development (Etzkowitz & Dzisah, 2008). The triple helix model focuses on interactions ongoing between universities – industry – government as the key to improving the conditions necessary to innovation, based on changing the paradigm from industrial societies to knowledge based societies.

Strengthening this perspective on regional competitiveness and development, the productive private sector capacity determines the prevailing levels of regional earnings and employability (Budd & Hirwist, 2004). From the Global Entrepreneurship Monitor perspective, the launch of new companies results in investment inflows, new jobs and driving overall competitiveness and development (Kelley et al., 2011).

The Triple Helix Triangulation relational model reflects the interaction of relationships ongoing between three institutional spheres (university – industry – government) designed to secure regional competitive advantage within the framework of actions interrelated across a multi-level scenario.

The Triple Helix Triangulation model thereby serves as the point of departure for designing and implementing empirically based studies, susceptible to providing responses to the questions raised relative to the interactions taking place in the different spheres. This is, in turn, based on the assumption of a positive relationship between the dynamics of innovation and entrepreneurship for regional competitiveness and development that needs empirical validation with recourse to the appropriate research methodologies (quantitative and/or qualitative).

Considering the pertinence of developing this theme in future research, and irrespective of the prevailing economic conjuncture – with recessionary pressures at the global level and reflecting in the rescaling and postponement of new investment projects despite the corresponding need for job creation within the framework of a globalised and competitive economy in which innovation stands out as a key factor for competitiveness, combine to ensure the priority attributed to regional development and its associated competitiveness. This inherently requires the dissemination of knowledge and technology through a sustainable inter-organisational network. Based on this assumption, as future lines of research, we would suggest the empirical testing of the Triple Helix Triangulation conceptual model as well as proposing new questions or hypotheses leading to the development of the model itself and a better alignment of the regional competitiveness perspective.

9. REFERENCES

Arroyo-Vázquez, M., Sijde, P., & Jiménez-Sáez, F. (2009). Innovative and creative entrepreneurship support services at universities. *Service Business*, *4*(1), 63-76. Doi:10.1007/s11628-009-0084-4.

Audretsch, D. B., Hülsbeck, M., & Lehmann, E. E. (2011). Regional competitiveness, university spillovers, and entrepreneurial activity. *Small Business Economics*. Doi:10.1007/s11187-011-9332-9

Baltzopoulos, A., & Broström, A. (2011). Attractors of Entrepreneurial Activity: Universities, Regions and Alumni Entrepreneurs. *Regional Studies*, (December), 1-16. Doi:10.1080/00343404.2011.602335

Bathelt, H., Kogler, D. F., & Munro, A. K. (2010). A knowledge-based typology of university spin-offs in the context of regional economic development. *Technovation*, *30*(9-10), 519532. Doi:10.1016/j.technovation.2010.04.003

Bramwell, A., & Wolfe, D. A. (2008). Universities and regional economic development: The entrepreneurial University of Waterloo. *Research Policy*, *37*(8), 1175-1187. Doi:10.1016/j.respol.2008.04.016

Budd, L., & Hirmisf, K. (2004). Conceptual Framework for Regional Competitiveness. *University Business*, *3*(December), 1015-1028. Doi: 10.1080/tl034340042000292

Cooke, P. & Leydesdorff, L. (2006). Regional Development in the Knowledge-Based Economy: The Construction of Advantage. *Journal of Tecnology Transfer, 31: 5-15, 2006.*

Dinapoli, T. P. (2011). The Economic Impact of Higher Education in New York State. *New York*, 1-4.

Eom, B.-Y., & Lee, K. (2010). Determinants of industry–academy linkages and, their impact on firm performance: The case of Korea as a latecomer in knowledge industrialization. Research Policy, 39(5), 625-639. Doi: 10.1016/j.respol.2010.01.015

Etzkowitz, H. (2003a). Innovation in Innovation: The Triple Helix of University-IndustryGovernment Relations. *Social Science Information*, *42*(3), 293-337. Doi: 10.1177/05390184030423002

Etzkowitz, H. (2003b). Research groups as “quasi-firms”: the invention of the entrepreneurial university. *Research Policy*, *32*, 109-121.

Etzkowitz, H. (2008). *The Triple Helix: University–Industry–Government Innovation in Action*. New York, Routledge. Doi:10.1080/09537320802426309

Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation□: from National Systems and “Mode 2” to a Triple Helix of university – industry – government relations. *Science and Technology*, 109-123.

Etzkowitz, H., & Dzisah, J. (2008). Rethinking development: circulation in the triple helix. *Technology Analysis & Strategic Management*, *20*(6), 653-666. Doi: 10.1080/09537320802426309

Galindo, P. V., Vaz, T. D. N., & Nijkamp, P. (2011). Institutional capacity to dynamically innovate: An application to the Portuguese case. *Technological Forecasting and Social Change*, *78*(1), 3-12. Doi: 10.1016/j.techfore.2010.08.004

Garrido-Yserte, R., & Gallo-Rivera, M. T. (2008). The impact of the university upon local economy: three methods to estimate demand-side effects. *The Annals of Regional Science*, *44*(1), 39-67. Doi: 10.1007/s00168-008-0243-x

GEM. (2007). *Global Entrepreneurship Monitor- Projecto GEM Portugal 2007*. *SSRN Electronic Journal*.

Gopalakrishnan, K., Yusuf, Y., Abubakar, T., & Ambursa, H. M. (2012). Sustainable supply chain management: A case study of British Aerospace (BAe) Systems. *International Journal os Production Economics*. doi:10.1016/j.ijpe.2012.01.003

Grant, R. M. (1991). Porter’s “competitive advantage of nations”: An assessment. *Strategic Management Journal*, *12*(7), 535-548. Doi:10.1002/smj.4250120706

Harris, J. D., Sapienza, H. J., & Bowie, N. E. (2009). Journal of Business Venturing Ethics and entrepreneurship ☆. Ethics, 24, 407-418. doi:10.1016/j.jbusvent.2009.06.001

Huahai, L., Xuping, Z., & Feng, Z. (2011). Regional Innovation System Efficiency Evaluation Based on the Triple Helix Model. *2011 International Conference on Business Computing and Global Informatization*, 154-157. Doi: 10.1109/BCGIn.2011.46

Kelley, D. J., Singer, S., & Herrington, M. D. (2011). *Global Entrepreneurship Monitor 2011. Global Report*.

Kim, Y., Kim, W., & Yang, T. (2011). The effect of the triple helix system and habitat on regional entrepreneurship: Empirical evidence from the U.S. *Research Policy*. 10.1016/j.respol.2011.08.003

Kirkwood, H. (2010). Challenges in Collection Development for Entrepreneurship. *Journal of Business & Finance Librarianship*, *15*(3-4), 220-220. Doi: 10.1080/08963568.2010.490056

Leydesdorff, L. (2011). The Triple Helix, Quadruple Helix, …, and an N-Tuple of Helices: Explanatory Models for Analyzing the Knowledge-Based Economy? *Journal of the Knowledge Economy*. Doi: 10.1007/s13132-011-0049-4

Leydesdorff, L., & Meyer, M. (2006). Triple Helix indicators of knowledge-based innovation systems Introduction to the special issue. *Research Policy*, *35*(10), 1441-1449. Doi: 10.1016/j.respol.2006.09.016

Lundberg, H., & Andresen, E. (2011). Cooperation among companies, universities and local government in a Swedish context. *Industrial Marketing Management*. Doi: 10.1016/j.indmarman.2011.06.017

McAdam, R., Miller, K., McAdam, M., & Teague, S. (2011). The development of University Technology Transfer stakeholder relationships at a regional level: Lessons for the future. *Technovation*, 1-11. Doi: 10.1016/j.technovation.2011.08.001

MacGregor, S. P., Marques-Gou, P., & Simon-Villar, A. (2010). Gauging Readiness for the Quadruple Helix: A Study of 16 European Organizations. *Journal of the Knowledge Economy*, *1*(3), 173-190. Doi: 10.1007/s13132-010-0012-9

Martin, F. (1998).The economic impact of Canadian university R&D. *Research Policy*, *27*(7),677-687.

Doi:10.1016/S0048-7333(98)00083-3

Nijkamp, P. (2003). Entrepreneurship in a Modern Network Economy. *Regional Studies*, 37(4), 395-405. Doi:10.1080/0034340032000074424

Nordqvist, M., & Melin, L. (2010). Entrepreneurial families and family firms. Entrepreneurship & Regional Development, 22(3-4), 211-239. Doi: 10.1080/08985621003726119

Porter, M. E., & Stern, S. (2001). Innovation□: Location Matters. *MIT Sloan Management Review*. Summer 2001; 42(4), 28-36

Porter, M. E., & Kramer, M. R. (2006). Strategy and Society: the link between competitive advantage and corporate social responsibility. *Harvard Business Review, 6 (December).*

Potts, T. (2010). The natural advantage of regions: linking sustainability, innovation, and regional development in Australia. *Journal of Cleaner Production*, 18(8), 713-725. Doi: 10.1016/j.jclepro.2010.01.008

Salvador, E. (2010). Are science parks and incubators good “brand names” for spin-offs? The case study of Turin. *The Journal of Technology Transfer*, *36*(2), 203-232. Doi: 10.1007/s10961-010-9152-0

Semlinger, K. (2008). Cooperation and competition in network governance: regional networks in a globalised economy. *Entrepreneurship & Regional Development*, 20(6), 547-560. Doi: 10.1080/08985620802462157

Schumpeter, J.A, 1942. *Capitalism, Socialism and Democracy*. New York , Harper and Row.

Schwab, K. (2010). *The Global Competitiveness Report 2010–2011*. *Forum American Bar Association*.

Smith, H. L., & Bagchi-Sen, S. (2010). Triple helix and regional development: a perspective from Oxfordshire in the UK. *Technology Analysis & Strategic Management*, *22*(7), 805818. Doi: 10.1080/09537325.2010.511143

Turok, I. (2004). Cities, Regions and Competitiveness. *Regional Studies*, *38*(9), 1069-1083. Doi: 10.1080/0034340042000292647

Van Looy, B., Landoni, P., Callaert, J., van Pottelsberghe, B., Sapsalis, E., & Debackere, K. (2011). Entrepreneurial effectiveness of European universities: An empirical assessment of antecedents and trade-offs. *Research Policy*, *40*(4), 553-564. Doi:10.1016/j.respol.2011.02.001

Viale, R., & Etzkowitz, H. (2010). The Capitalization of Knowledge: A Tripla Helix of University-Industry-Government. (R. Viale & H. Etzkowitz, Eds.) (1st ed., p. 351). Cheltenham, UK: Edward Elgar Publishing.

Wong, P. K., Ho, Y. P., & Autio, E. (2005). Entrepreneurship, Innovation and Economic Growth: Evidence from GEM data. *Small Business Economics*, *24*(3), 335-350. Doi: 10.1007/s11187-005-2000-1

Yusuf, S., & Nabeshima, K. (2007). *How Universities Promote Economic Growth*. *Human Development*. The international Bank for reconstruction and development/The World Bank. Washington DC, 2007.

PROMOTION OF A REGIONAL INNOVATION SYSTEM: THE CASE OF THE STATE OF MEXICO

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Abstract
The state of Mexico is one of the most important Mexican states in terms of population and contribution to GDP. Nevertheless its competitiveness is ranked very low according to different benchmarking studies of the Mexican states. One priority strategic issue to overcome such a lack of competitiveness is to foster innovation through the increase of private sector investments in R&D and the improvement of the links among firms, research organizations, universities and government. In this framework, the Mexico-State Council of Science and Technology (COMECYT) has launched an initiative to strengthen the local innovation system, in alliance with the Inter-American Development Bank (IDB) and the National Council of Science and Technology (CONACYT). The starting point of this initiative is the definition of the state's innovation agenda departing from a comprehensive diagnosis of current capabilities, resources for innovation and policy instruments, and a priority-setting process with participation of representatives of the triple helix model: firms, research institutions and local government. Once this agenda is available, sectorial networks are being built to facilitate interaction and collaboration for innovation. Matching funds for cooperative innovation projects are being offered to SMEs as an economic incentive to promote private investment and institutional links. Capacity-building has been identified as a critical factor for success of this initiative and for that reason high-level training on innovation policies and management is being implemented for staff of firms, universities, R&D centers and government institutions. This paper deals with the analysis of this experience, identifying factors of success, problems for the definition of the agenda and the main obstacles for the implementation of the different policy measures of this initiative.

Keywords: State Innovation System; Innovation Agenda; sectorial networks; financing innovation investments of SME.

IN SEARCH OF SOME INDONESIA PROMINENT SECTORS ACCORDING TO ASEAN FREE TRADE AREA 2015

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Abstract
ASEAN Free Trade Area (AFTA) in year 2015 has aim to augment the South East Asian market with respect to terms of free trade. The AFTA is mainly driven by eliminating trade barriers ultimately through lowering the tariff up to 0 %. Regarding this AFTA agreement, Indonesia as a founding ASEAN is automatically engaged by the AFTA policy and involved within improving the rules of origin of AFTA including in the applied of lowering tariff as well. To some extent, Indonesia must set its tariff up to 0% for certain commodities. On this occasion, this paper has aim to assess these Indonesia's certain commodities in order to ascertain what are the prominent sectors in comparing Indonesia with its ASEAN trading partners, particularly ASEAN 5, namely: Brunei, Malaysia, Philippines, Singapore and Thailand. Moreover, this paper employs a modified Gravity Equation framework to expose some significant result of both two essential parameters such F-test and Adjusted R-square. This paper found that the opportunity sectors for Indonesia in AFTA 2015 are better to its natural comparative advantage. In another word, the prominent sectors for Indonesia are placed by rubber based-products, wood based products, agro based-products and fisheries.

Keywords: AFTA 2015; Indonesia prominent sectors; a modified gravity equation framework

1. Introduction

To foster economic growth and scale in regionally, since 1992 the ASEAN countries applied economic integration by beginning with ASEAN Free Trade Area (AFTA). Eliminating trade barriers gradually is appointed out in order to convince that ASEAN free trade well implemented. The AFTA has a vital function to bolters the trade volume dramatically. According to ASEAN Economic Community (AEC) Chart Book [1], there are seven sectors initially and primary to be fully integrated namely agro-based products, automotive, electronics, fisheries, rubber based-products, textiles and apparels, and wood-based products until 2015.

In response to these seven sectors, Indonesia might have an opportunity to reveal on what prominent sectors are Indonesia attempts to let out for free trade yet must be beneficial as well. This paper has a purpose to search the Indonesia prominent sectors as its excellent comparative advantage scientifically by employing a robust Gravity Equation framework. Furthermore, the original contribution for this paper is the assessment matrix of Indonesia prominent sectors to its selected members of ASEAN namely Singapore, Malaysia, Thailand and Philippines. Actually these countries including Indonesia are the founding fathers of the ASEAN establishment since 1967.

2. Literature Review

a. Some basic terminologies of the economic integration and free trade

Regarding Dennis and Yusof [2], integration involves the combination of parts into a whole. Embedded is the idea of increasing the size and coverage of the entities involved. While the term integration usually refers to international integration which involves countries, it can also refer to national integration which involves regions within countries. Essentially, integration can be interpreted either in the wider or narrower sense. Furthermore, they explain more detail that the narrow sense of integration covers only the notion of economic integration. The wider concept of integration tends to include more than the idea or notion of economic integration and to include political and social integration too. Then, they interpreted too that economic integration is seen as a means of securing access to wider markets and to promote economic growth and hence to raise welfare. Then, Park [3] defined that the economic integration in a broad sense can be viewed as increasing economic activities such as trade and foreign direct investment in a geographic region and reducing the importance of national boundary in the economic arena. He also said that the increasing degree of economic integration in the region can be seen from trade and investment patterns of the region. Venables [4] said that economic integration called as a regional economic integration which occurs when countries come together to form free trade areas or customs unions, offering members preferential trade access to each other' market. He emphasizes regional integration into 'deeper integration in terms of international trade' that it can be pursued by going beyond abolition of import tariffs and quotas, to further measures to remove market segmentation and promote integration.

For free trade, the most feature basic terminology had been introduced by David Ricardo in earlier 19th century. Ricardo said that International trade in goods and services takes place because countries have different resource endowments and labor skills and because consumer tastes vary from country to country. To support previous argument, he argued that a country could gain from trade even when another country had an absolute advantage in producing all goods and services. Ricardo's approach is based on the hypothesis of international capital immobility. Thereby, rightly, that by concentrating on producing those goods and services in which a country was relatively more efficient and importing those product in which it was relatively less efficient, it could increase its national income. And this would be so even if that country was absolutely less efficient in producing all products. In other words, international capital immobility leads to specialization in terms of *comparative advantage.*

Nevertheless, Carchedi [5] made some critical reviews for the Ricardo's Theory. *First*, since modern economies are characterized by capital mobility, the theory is irrelevant for modern day capitalism. *Second*, the theory is does not fit historical evidence. Since Ricardo's theory assumes implicitly that international specialization leads to a harmonious and well balanced development in which all sides concerned to gain, development and under development as two sides of the same coin fall outside its scope. *Third*, comparative advantages rest on the impossible quantitative comparison of two differ goods. *Fourth*, and most importantly, the theory assumes that in a capitalist system country specialize in those sectors in which labor can be saved. Under capitalism production is for profit and countries specialize in those sectors in which their capitalists can realize the highest profit rates. This situation also validates to absolute advantages. In a capitalist system, productivity differentials can be meaningfully compared only within sectors. In this case, they do indicate profitability differentials. Such a comparison is meaningless across sectors.

Those points from Carchedi could be saying just followed by a few scientists. Some of which linkage to free trade are favor of utilizing Ricardo Theory. One of the follower of Ricardo Theory in earlier 21th century world is Dodge [6] that saying once countries export goods and services in which they are less competitive, consumers everywhere benefit, the potential output of all nations increases, and so does the global standard of living. In the end, competitive pressure leads to greater efficiency, greater productivity, and higher standard of living. Another side, free trade needs adjustment costs to be borne as barriers to trade removed. This is part of the process of releasing resource both human and physical to those industries or firms that are taking advantage of new markets abroad. The partial conclude is some kind of mechanism to equitably share the short run costs of adjustment is important to reap the medium and longer run benefits of free trade.

b. The typology of economic integration

Mattlin [7] derived the typology of theoretical integration constellations from empirical cases with varying combination of economic dependence and shared identification: symmetric and weak symmetric integration, two types of asymmetric integration and no integration.

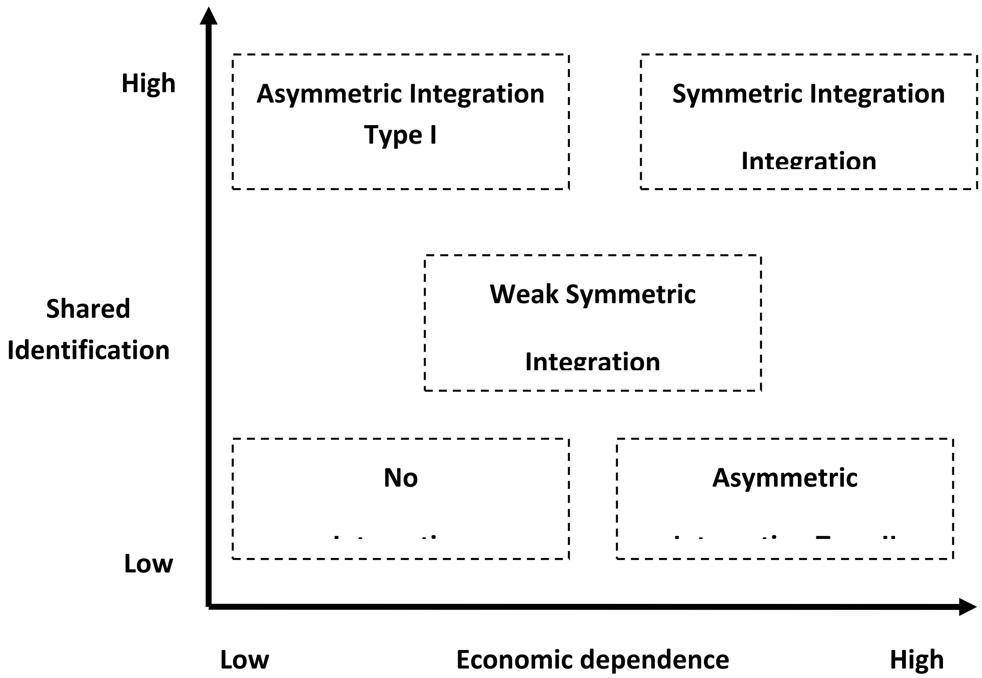

Fig. 1.Five theoretical integration

Asymmetric integration type I explores integration between state entities with high shared identification where political integration is mutually desired but has previously been impeded because of contradictory security relationships. However, structural economic integration lags institutional integration. In the symmetric integration refers a situation where economic dependence and shared identification initially are high and the economic dependence with structural economic integration also high.

For instance, the weak symmetric integration is inferred that a situation where economic dependence and shared identification initially are less clear, but where political or institutional integration nonetheless has occurred more or less in step with structural economic integration. The no integration implies a situation where both economic dependence and shared identification are low. In such cases, there is no political integration being considered. Asymmetric integration Type II describes the opposite situation in which extensive economic dependence amid a lack of shared identification, and presumably therefore no desire for political integration on the part of the weaker entity. Structural economic integration therefore occurs without an institutional framework for it.

c. *The gravity equation framework*

The Gravity Equation framework some ways has been indicated as a robust instrument to make a plausible analysis in terms of free trade. The basic of Gravity Equation framework can be expressed as:

$$T_{ij} = A \times Y_i^a \times {Y_j^b}/{D_{ij}^c} \quad (1)$$

T_{ij} is the value of trade between country i and country j, Y_i is country i's GDP, Y_j is country j's GDP, and D_{ij} is the distance between the two countries. This general Gravity Equation model is cited from Krugman and Obstfeld [8]. The trade between any two countries is, other things equal, proportional to the product of their GDPs and diminishes with distance. In addition, Krugman and Obstfeld implied three importance of role of Gravity equation framework: *first*, in relation with 'the size matters of Gravity Model': There is a strong empirical relationship between the size of a country economy and the volume both its imports and its exports.
Second, in relation with 'the logic of the Gravity Model': Why does the gravity equation work? Broadly speaking, large economies tend to spend large amounts on imports because they have large incomes. They also tend to attract large shares of other countries' spending because they produce a wide range of products. So the trade between any two economies is larger. *Third*, in relation with the looking for anomalies using the Gravity Model: In fact, one of the principal uses of gravity models is that they help us to identify anomalies in trade. Indeed, when trade between two countries is either much more or much less than a gravity model predicts, economist search for the explanation.

3. The Framework

To some extent, this paper employs a Modified Gravity Equation framework in capturing of the dynamics of bilateral trade flows between Indonesia and other selected ASEAN members. The framework can be written as following equation:

$$\log \sum TBAuto_{ij} = \alpha_1 + \alpha_2 \log Y_i + \alpha_3 \log Y_j + \alpha_4 \log D_{ij} + \alpha_5 \log t_i + \alpha_6 \log t_j + \alpha_7 \log ex_i + \alpha_8 \log ex_j + \log e_{ij} \quad (2)$$

$$\log \sum TBRubber_{ij} = \alpha_1 + \alpha_2 \log Y_i + \alpha_3 \log Y_j + \alpha_4 \log D_{ij} + \alpha_5 \log t_i + \alpha_6 \log t_j + \alpha_7 \log ex_i + \alpha_8 \log ex_j + \log e_{ij} \quad (3)$$

$$\log \sum TBWood_{ij} = \alpha_1 + \alpha_2 \log Y_i + \alpha_3 \log Y_j + \alpha_4 \log D_{ij} + \alpha_5 \log t_i + \alpha_6 \log t_j + \alpha_7 \log ex_i + \alpha_8 \log ex_j + \log e_{ij} \quad (4)$$

$$\log \sum TBAgro_{ij} = \alpha_1 + \alpha_2 \log Y_i + \alpha_3 \log Y_j + \alpha_4 \log D_{ij} + \alpha_5 \log t_i + \alpha_6 \log t_j + \alpha_7 \log ex_i + \alpha_8 \log ex_j + \log e_{ij} \quad (5)$$

$$\log \sum TBTextiles_{ij} = \alpha_1 + \alpha_2 \log Y_i + \alpha_3 \log Y_j + \alpha_4 \log D_{ij} + \alpha_5 \log t_i + \alpha_6 \log t_j + \alpha_7 \log ex_i + \alpha_8 \log ex_j + \log e_{ij} \quad (6)$$

$$\log \sum TBFisheris_{ij} = \alpha_1 + \alpha_2 \log Y_i + \alpha_3 \log Y_j + \alpha_4 \log D_{ij} + \alpha_5 \log t_i + \alpha_6 \log t_j + \alpha_7 \log ex_i + \alpha_8 \log ex_j + \log e_{ij} \quad (7)$$

$$\log \sum TBElectro_{ij} = \alpha_1 + \alpha_2 \log Y_i + \alpha_3 \log Y_j + \alpha_4 \log D_{ij} + \alpha_5 \log t_i + \alpha_6 \log t_j + \alpha_7 \log ex_i + \alpha_8 \log ex_j + \log e_{ij} \quad (8)$$

Where

- $\sum TB_{ij}$ is sum value of trade balance (net exports) of automotive, rubber based-products, wood based-products, agro based-products, textiles and apparels, fisheries and electronics from Indonesia *(i)* to other selected ASEAN members *(j)* in US Dollar;
- α_1 is constant or unobserved effect;
- $Y_{it};Y_{jt}$ are GDP per capita of Indonesia and other selected ASEAN members GDP per capita in US Dollar
- D_{ij} is distance between Indonesia capital city *(i)* and other selected ASEAN members capital cities *(j) in* km;

- t_i is Indonesia average CEPT rates *(i)* in percentage;
- t_j is selected ASEAN members average CEPT rates *(j)* in percentage;
- ex_i is Indonesia real exchange rates *(i)* in per US Dollar;
- ex_j is selected ASEAN members average CEPT rates *(j)* in per US Dollar;
- e_{ij} is lognormal error term.

The data was taken from the International Trade Centre [9] in which providing the trade balances information. Then, data of the GDP per capita plus the CEPT, the distance, and real exchange rates are supported by www.asean.org [10], www.indo.com/distance [11] and added by www.geobytes.com/citydistancetool.htm [12], and International Financial Statistic [13], respectively. The time period all of the data are from 2002 to 2008.

Pooled Least Square (PLS) regression or Constant Coefficients Model is employed to produce a gravity equation regressed based on a panel data. This method is assumed that explanatory variables (independent variables) are non stochastic. If they are stochastic, they are uncorrelated with the error term. Sometimes it is assumed that the explanatory variables are 'strictly exogenous. Regarding Gujarati and Porter [14] that a variable is said to be strictly exogenous if it does not depend on current, past, and future values of the error term. It is also assumed that the error term is $e_{ij} \sim iid(0, \sigma_e^2)$, that is, it is independently and identically distributed with zero mean and constant variance and also may be assumed that error term is normally distributed.

The PLS result will provide two estimations as a baseline to analyze Indonesia bilateral trade flows with selected trading counterparty: *first*, the adjusted R^2, according to Aczel [15] that is a descriptive measure of the strength of the regression relationship, a measure of how well the regression line fits the data. Moreover, he mentions that the requirement of an indication of the relative fit of the regression model to the data such R^2 value of 0.9 or above is very good, a value above 0.8 is good, a value of 0.6 or above may be satisfactory, a value of 0.5 or below maybe poor. Nonetheless, accordingly, this paper implements some adjustments in which the interval value of the adjusted R^2 ranges from 0 % to 25 %; 26 % up to 50%; and 51% to 100 % indicate as a poor sector of Indonesia, as a weak sector for Indonesia and as a prominent sector for Indonesia respectively.

Second, prob.(F-stat) or F-test or testing the overall significance of PLS. To test the hypothesis would be $H_0 : \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = \alpha_7 = \alpha_8 = 0$ and H_1: not all slope coefficients are simultaneously zero. If the ρ-value or prob. (F-stat) is less than any level of significance α by 1%, 5%, or 10 %, so the null hypothesis will be rejected. It means all independent variables or explanatory variables are simultaneous affecting the dependent variable. These estimations have a function to make a plausible interpretation of parameter as whole in relation with the dynamics terms of trade between Indonesia and other selected ASEAN members.

4. Finding and Discussion

Table 1.Gravity equation estimation of Indonesia bilateral trade analysis

		Auto.	Rubber based-products	Wood based-products	Agro based-products	Textiles and apparels	Fisheries	Electronics
Indonesia to Malaysia	Adj. R^2	0.284662	0.248718	0.677137	0.544942	0.180906	0.713238	0.378958
	F-test	0.001271**	0.003399*	0.000000*	0.000000*	0.017944**	0.000000*	0.000067*
Indonesia to Singapore	Adj. R^2	0.367988	0.446564	0.596437	0.701265	0.176577	0.764817	0.276319
	F-test	0.000097*	0.000006*	0.000000*	0.000000*	0.019790***	0.000000*	0.001608**
Indonesia to Thailand	Adj. R^2	0.367988	0.726532	0.577371	0.795372	0.059648	0.662725	0.235126
	F-test	0.000097*	0.000000*	0.000000*	0.000000*	0.190565	0.000000*	0.004839*
Indonesia to Philippines	Adj. R^2	0.424752	0.433426	0.669456	0.741487	0.317328	0.31728	0.267734
	F-test	0.000013*	0.000009*	0.000000*	0.000000*	0.000488*	0.000488*	0.002039*
N. Observations		63	63	63	63	63	63	63

*, **, *** indicate that the estimated coefficients are statistically significant or not by 1%, 5%, or 10 %

The table above depicts that the signifying of F-test is possessed by all sector from automotive sector to electronics. Yet, the significance might be spurious information since the parameters work simultaneous to influence the notation of trade balance as a dependent variable. To overcome such issue, the utilizing of adjusted R^2 is a must. The adjusted R^2 has capable of identifying the classification of each sector. Thus, from the empirical trade patterns point between Indonesia and Malaysia the prominent sectors in as much are just for fisheries sector (71.3%), wood based-products (67.8%), and Agro based-products (54.5%).

Then, Indonesia and Singapore may imply the same pattern as previous trade flows. The magnitude of F-test indicates that every sector contributes to enlarge trade balance both countries. Nonetheless, the fisheries sector, agro based-products, and wood based-products as well are inferred as strategic sectors for Indonesia in trade relation with Singapore. he table 1 also gives information that which is no doubt that the F-test results come out with significant. The trade balance between Indonesia and Thailand expose higher tension close to AFTA 2015. However, this examination is not sufficiently enough to reveal Indonesia prominent sectors. Hence, according to the adjusted R^2 , in proper way, except automotive, textiles and apparels, and electronics, the rests imply prominent sectors for Indonesia.

Inevitably, since the F-test denotes the significance, all sectors are accentuated to augment the trade balance between Indonesia and Philippines. These deduce the trade expand between two countries may predict increased rapidly in response to AFTA 2015. Nevertheless, the sectors must be further selected because of strengthening the prominent sectors being first priority for Indonesia in conducting AFTA 2015. Eventually, the prominent sectors for Indonesia linkages to Philippines will be conditioned by the underlying of the adjusted R^2 . Thereby, the Indonesia immense sectors in terms of trade with Philippines are agro based-products and wood based-products.

In further analysis, this paper has an effort to satisfy the poor and weak sector by forming a matrix for both of those in which prominent sectors including in over there. The importance of this matrix is to mapping each Indonesian sector due to its F-test then combining with adjusted R-square thereby obviously associated to the existence of positioning of each sector. The matrix can thus simple be derived like below:

Table 2.The matrix positioning of Indonesia sector in free trade relative to its counterpart

	Sector	Poor	Weak	Prominent
Indonesia to Malaysia	Automotive		√	
	Rubber based-products	√		
	Wood Based-products			√
	Agro Based-products			√
	Textiles and apparel	√		
	Fisheries			√
	Electronics		√	
Indonesia to Singapore	Automotive		√	
	Rubber based-products		√	
	Wood Based-products			√
	Agro Based-products			√
	Textiles and apparel	√		
	Fisheries			√
	Electronics		√	
Indonesia to Thailand	Automotive		√	
	Rubber based-products			√
	Wood Based-products			√
	Agro Based-products			√
	Textiles and apparel	√		
	Fisheries			√
	Electronics	√		
Indonesia to Philippines	Automotive		√	
	Rubber based-products		√	
	Wood Based-products			√
	Agro Based-products			√
	Textiles and apparel		√	
	Fisheries		√	
	Electronics		√	

The illustration for the option of poor, weak or prominent sector would be elaborated by assessing the F-test instead. Moreover, while the F-test of one sector is significance yet the adjusted r-square occurs below criteria of 50% so that this sector indicates either weak (26-50%) or poor (0-25%). In oppose with weak and poor, there is prominent which has the estimation of adjusted r-square above the 50%, exactly the range from 51% up to 100%.

The table 2 depicts that noticing Indonesia and Malaysia in which the rubber based-products and textiles and apparels are due to poor sector. For instance, automotive and electronic sector are definitely ascertained as weak sector for Indonesia. It is noticeable that wood based-products, agro based-products and fisheries in place of as Indonesia prominent sectors by trading with Malaysia in AFTA 2015. Featuring poor and weak sector, Indonesia may not focus to these types of sector with Malaysia. Substantially, Malaysia is recognized as a strong country in creating its own automotive particularly automobile product namely Proton. With respect to rubber based-products, Malaysia as noted had been enhancing its rubber industries besides Indonesia. Hence, no wonder Malaysia is also strong for this kind industry. Rely on electronics sector, Malaysia might be in favor much more trading with other countries and

Indonesia emulates the same way as well. Therefore, talking about these sectors Indonesia to some extent is not compulsory to increase its trading volume in practice for AFTA 2015.

Interestingly, the trade flows between Indonesia and Singapore are relatively resembled pattern with Indonesia and Malaysia. The Indonesia prominent sectors are allocated to wood based-products, agro based-products and fisheries. Textiles and apparels sector is associated with poor sector. The rest is denoted as weak sector. Moreover Singapore is identified as developed countries in South East Asian region which is its positioning a few grades under G-8 countries. Hence, no doubt that Singapore had been inducing sophisticated technology since more than a decade ago. By then, Singapore has a competitive advantage for its high tech electronics sector and automotive as well. Most of big fish corporation in relation with both sectors prefer opened their branch in Singapore rather than other capital cities in South East Asian. Yet, the textiles and apparel industries in Singapore are relatively assumed being not growing like in Indonesia. Because its population indicates very small rather than the rest founder ASEAN countries.

The characteristic terms of trade between Indonesia and Thailand are seemed more dynamics than others. The Indonesia strength of which instead of Thailand is captured within sector of rubber based-products, wood based-products, agro based-products, not mentioning fisheries. Textiles and apparels and electronics sector are exhibited as Indonesia poor sector. As noted in weak sector features automotive sector. The baseline of economy Thailand is agro based-products by establishing its agriculture stronger than others. In this sector Thailand might be better off than Indonesia a little bit yet only for selected commodities such some fruits. Indonesia might be robust on wood based-products and fisheries sector rather Thailand. Due to rubber based-products, the positioning of each is relatively equals because Thailand is inferred powerful in rubber industries in which the same condition as Indonesia.

In response to trade flow between Indonesia and Philippines, except wood based-products and agro based-products sector the rest implies as weak sector. Philippines might be presumed a country which has abundant fisheries resources according to its geographical close to South China Sea and Pacific Ocean. Its fisheries are more absorbed significantly by China and Japan than Indonesia. Philippines in trade expands outside ASEAN actually are more delighted to import its necessary on automotive, textiles and apparels and electronics products from China and Japan particularly.

5. Concluding Remark

1. This paper found that the opportunity sectors for Indonesia in AFTA 2015 are better to its natural comparative advantage. In fact, Indonesia actually is rich with natural resources compared to others. This paper summarizes in as much that the natural comparative sectors can be saying dominated Indonesia trade flows with its counterpart. In another word, the prominent sectors for Indonesia are placed by rubber based-products, wood based products, agro based-products and fisheries. Accordingly, the Indonesia government not should but must be incorporating industries linkage to these by issuing the strategic policy to protect from trade rivals invasion. One of tactical a strategic policy is state-owned enterprises have a role to processing and managing a large number of natural resources in Indonesia then generating excellent products in competing with Malaysia, Singapore, Thailand and Philippines regarding the AFTA 2015.
2. This strategic policy notices as an urgent circumstances because Singapore and Malaysia can be said that already constructed their trusted country corporation and trade policy as well to secure their products ready to play in free trade. By and large, from perspective academicians this paper tries to contribute a recommendation in which Indonesia is inherent suggested to enhance its infrastructure and its supporting policies massively in order to back up industries of prominent sectors. Some products are produced in some ways must dramatic increased their value added to obtain huge beneficial from free trade. By doing this, Indonesia can be predicted being a key player to bolster trade opportunities in AFTA 2015.

References

[1] ASEAN Secretariat. *ASEAN economic community chart book*. Jakarta, September 2009, p. 47-49.

[2] Dennis, J. David and Yusof, Z. Aznam. *Developing indicators of ASEAN integration-a preliminary survey for a roadmap*. REPSF Project 02/001: Econsult Sdn Bhd Malaysia, Final Report, August, 2003.

[3] Park, H. Kang. A test of financial integration in East Asia. Multinational Business Review; Spring 2005, Vol. 13, No.1; ABI/INFORM global p.75-95.

[4] Venables. J, Anthony. International trade; regional economic integration. *International Encyclopedia of Social and Behavioral Sciences,* article 3.4 34, London School of Economics, 10 July 2000.

[5] Carchedi, Guglielmo. *For another Europe: a class analysis of European economic integration*. London and New York: Verso; 2001, Chapter 2.

[6] Dodge, David. (2003). Economic integration in North America. *Bank of Canada Review*, Autumn 2003; ABI/INFORM Global, p. 45-50.

[7] Mattlin, Mikael. Structural and institutional integration: asymmetric integration and symmetricity tendencies, cooperation and conflict. *Journal of the Nordic International Studies Association*, Sage Publication, Vol. 40(4): 403-421, 2005.

[8] Krugman, Paul R. and Maurice Obstfeld. *International economics: theory and policy*. Addison-Wesley; 2009, 8th ed.

[9] International Trade Center. http://www.trademap.org/selectionmenu.aspx. Access on October 2010.

[10] ASEAN Free Trade Area Council. http://www.asean.org/19585.htm. Access on April 2010.

[11] Bali and Indonesia on the Net. http://www.indo.com/distance. Access on March 2010.

[12] City Distance Tool. http://www.geobytes.com/citydistancetool.htm. Access on March 2010.

[13] International Monetary Fund. International Financial Statistic 2009.

[14] Gujarati, N., Damodar and Porter, C., Dawn. (2009). *Basic econometrics*. McGraw-Hill International Edition; 2009, 5th ed.

[15] Aczel, D., Amir. *Statistics concepts and applications*. Irwin; 1995.

PATTERNS OF INTERNATIONAL MOBILITY OF RESEARCHERS: EVIDENCE FROM THE GLOBSCI SURVEY

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Abstract
The contribution of foreign-born scientists and engineers in all advanced economies is sizable. In the US, science and engineering degrees granted to foreign-born have steadily increased overtime and the increase has been steeper during the 2000s. Foreign-born and foreign-educated scientists are also known to be disproportionately distributed among those that made exceptional contributions in science. General statistics for EU countries are almost completely lacking. In this paper we address the issue of patterns of international mobility of scientists by exploiting a new dataset deriving from the GlobSci survey, conducted in the spring of 2011 by the three authors and supported by grants from the Italian Government and from the National Bureau of Economic Research (USA). The survey is unique in that it studies scientists working in 16 "core" countries (Australia, Belgium, Brazil, Canada, Denmark, France, Germany, India, Italy, Japan, Netherlands, Spain, Sweden, Switzerland, UK, USA) allowing the comparison of patterns of researchers' inflows and outflows. The methodology involved surveying corresponding authors of articles published in 2009 in four fields of science who were studying or working in one of 16 core countries. The four fields are biology, chemistry, earth and environmental sciences, and materials. Collectively the 16 core countries produce about 70 percent of all articles published in these fields. The overall response rate was 40 percent. This resulted in about 19,000 completed responses. The survey data include detailed information at the individual level for both mobile and non-mobile researchers. Surveyed scientists currently working in one of the core country come from more than 100 source countries. In the paper we initially present and discuss the new evidence on mobility patterns. In particular, we show for each of the "core" countries the most relevant source countries and destination countries. We then move to the analysis at the individual level of: i) the motivations for leaving the country of origin; ii) the likelihood of returning to the country of origin; iii) the correlation between mobility and international scope of co-authorships. Moreover, in order to assess the impact of international mobility on the competitiveness of national scientific systems we analyse whether, after accounting for individual and field-specific characteristics, there are significant variations in the quality of scientific output of emigrated scientists, scientists that had international scientific experiences and non-mobile researchers. Finally, we discuss the policy implications of the overall evidence from the perspective of both destination and source countries.

Keywords: International mobility of researchers, Brain drain, Research quality, Survey data

1. INTRODUCTION

The capability of a country to attract foreign-born talents is fundamental to sustaining and building the quality of national science and engineering workforces. The contribution of foreign-born scientists and engineers in all advanced economies is sizable. In the US, science and engineering degrees granted to foreign-born have increased overtime. Currently, approximately 48 percent of all PhDs awarded in the United States go to those who are either temporary or permanent residents. Recent data reveal that 41.6 percent of those with doctorates working in a science and engineering occupation in 2009 were born outside the United States (National Science Board, 2012, table 3-28). Almost 60 percent of all postdocs working in the United States are on a temporary visa (Stephan 2012). Significant mobility is present also across European countries. A study of postdoctoral researchers working in Europe in the life sciences, for example, found that 43 percent were working in a country different than that of origin (Empirica, 2005).

Foreign-born and foreign-educated scientists are also known to be disproportionately distributed among those that make exceptional contributions in science (Stephan and Levin, 2001). Hunter et al. (2009), for example, found that 50 percent of all the highly-cited PhD physicists in the world work in a different country than that in which they were born. Stephan and Levin (1999) found exceptionally productive scientists and engineers working in the United States, defined by a number of measures, to have a higher probability of being foreign born and foreign educated than the underlying population of U.S. scientists.

The brain circulation issue is tightly related to increasing scientific globalisation and competition worldwide: mobility generates benefits in terms of speed and breath of knowledge production and diffusion but poses also concerns for the scientific leadership of westerns countries (Freeman, 2010; Franzoni et al. 2011). Amid a context of intense international mobility, national science and innovation systems compete to attract the best and brightest. They also compete to retain their share of national talents and to attract back those who have migrated to study or work abroad.

However, the gains from international migration are not only accrued by countries that succeed in attracting the most talented at the expenses of countries that loose their best resources. Personal and professional ties often remain between migrants and their country of origin or prior residence and constitute an invisible backbone enabling reverse knowledge flows (Saxenian 2002). Previous contributions have highlighted the presence of a complex network of links between migrations' of researches and the generation and transformation of scientific networks (Melin, 2004; Jonkers and Tijssen, 2008). Research and innovation policies, particularly in Europe, have strongly supported international mobility of the high skilled workforce as a tool to enhance the overall scientific performance of both source and destination countries. However, few empirical systematic investigations exist on the topic, in part because of the lack of internationally comparable data, particularly for Europe[10]. Most of available evidence on the effects of international mobility of scientists is based on the observation of scientists from specific countries and disciplines or of those researchers that applied for specific publicly sponsored mobility programmes[11].

[10] Two recent studies have gathered data on mobility of doctorate holders in Europe: the Careers of Doctorate Holders (CDH) developed by OECD and UNESCO (Auriol, 2010) and the MORE project (2010), funded by the European Commission. The CDH study focuses on all doctorate holders; data reported vary by date, depending upon country. The MORE study of researchers at universities has an exceptionally low response rate of 11percent and thus provides, at best, a noisy picture of mobility of scientists within Europe and to the United States. In the US the National Science Foundation's Survey of Doctorate Recipients does not track individuals trained in the United States who subsequently leave the United States restraining the posibility to fully analyse the effects of migration.

[11] Edler et al. (2011) analyse a sample of about 950 German academics from science and engineering faculties and investigate thorugh a survey how the duration and frequency of scientists' visit abroad affect technology transfer propensity, finding a positive effect of mobility in both the origin and host country. Hunter et al. (2009) collect data on the movement and productivity of elite scientists. They find that mobility is remarkable in this group: nearly half of the world's most-cited physicists work outside their country of birth and they tend to migrate systematically towards nations with large R & D spending. Laudel (2005) also analyse the brain drain of elite scientists in two specific scientific fields (angiotensin and vibrational spectroscopy) using bibliometric data. The data reveals the presence of relevant field heterogeneity in migration rates and highlight that migration generally occurs before scientists have gained the 'elite' status. Furukawa et al. (2012) trace the movements of about 2,200 researchers in the domains of robotics, computer vision and electron devices using a bibliometric approach based on affiliation countries. Their results confirm that the US, China and India exhibit the greatest global flows of researchers. Filippo et al. (2009) present an analysis of mobility patterns and scientific performance based on a case study of Spanish universities.

This paper contributes to this debate by providing new data on international mobility patterns of researchers working in four scientific fields and exploring the links between scientists' migration and the establishment of international research networks. Data come from the GlobSci survey, conducted in the spring of 2011 by the three authors[12]. The survey is unique in that it studies scientists working in 16 "core" countries: Australia, Belgium, Brazil, Canada, Denmark, France, Germany, Italy, India, Japan, Netherlands, Spain, Sweden, Switzerland, UK, USA. The methodology involved surveying corresponding authors of articles published in 2009 in four fields of science who were studying or working in one of the 16 countries. The four fields are biology, chemistry, earth and environmental sciences, and materials. Collectively the core countries produce about 70 percent of all articles published in these fields. The overall response rate was about 40 percent (Franzoni et al., 2012). The survey resulted in 19,183 records. The size and international scope of the survey allow us to produce a comprehensive picture of mobility patterns based on the mobility status of active researchers in 2009. Moreover, the data collected through the survey allow us to consistently control for a number of individual characteristics that cannot be observed through alternative research approaches such as bibliometric indicators or the analysis of the CVs of researchers.

In the paper we initially present our summary statistics on the incidence of foreign-born active researchers in the 16 core countries. For countries like the US our data complement extant statistics while for some European and non-European countries (e.g. Brazil and India) the data represent currently a completely new evidence directly comparable across countries. For each core country we analyse the composition of inflows and outflows of researches. We then develop different econometric models that assess for the 16 core countries the presence of significant differences in the capability to establish international collaborations between foreign-born researchers, native researchers who had an international training or working experience and subsequently returned, and native non-mobile researchers.

The evidence on foreign-born patterns indicates a high heterogeneity across the 16 core countries. The incidence of foreign-born researchers ranges from a high of 56.7% for Switzerland to a low of less than 0.8% for India. The rate for the US is 38.4%, close to that for Sweden (37.6%) but lower than that of Canada (46.9%) and Australia (44.5%). The rate for Japan is low (5.0%) and fairly close to that for Italy (3.0%). The data on mobility patterns reveals that both cultural and geographical links matters in explaining the composition of the main source countries.

The analyses on the impact of foreign-born scientists and returnees on the international openness of research networks reveal a number of interesting factors. First, a sizable share of foreign-born scientists included in our sample (about 40%) declare to have research collaborations with research groups located in their origin country. Second, we find robust evidence suggesting that both foreign-born scientists and returnees have larger international research networks than do native researchers in the core countries who lack an international background. Such patterns appear to hold even when we conduct analyses separately for the US, European countries and other countries.
Third, we also find that internationally co-authored papers with a foreign born or returnee corresponding author tend to have on average a higher scientific standing than those with a native non-mobile corresponding author. Interestingly, the effect on international collaborations and research quality for foreign born researchers turns out to be driven mostly by migrants who did not get their PhD in the destination country, but rather came for a post-doc position or directly for employment at a university or public research centre in the destination country. Such results suggest that previous research links owned by the mobile researchers matter. More generally, the overall evidence suggests the presence of a non-trivial impact of international mobility on the international openness of the research system of destination countries. Results have clear policy implications in light of the high heterogeneity in the patterns of foreign-born attractiveness and returnee rates across the analysed core countries.

The paper is organised as follows. In section 2 we introduce the characteristics of the GlobSci survey, the related datasets and discuss the evidence on international mobility patterns for the 16 core countries. In section 3 we present the econometric modelling of the data and show results. Section 4 summarises and discusses the main findings.

[12] The Global Science Project (GLobSci) has been funded by the Italian Governmenet (Regione Piemonte) and the National Bureau of Economic Reserach (NBER, USA).

2. DATASET AND STATISTICS

2.1 The GlobSci survey

We surveyed active researchers in the four scientific disciplines of biology, chemistry, earth and environmental sciences, and materials science during the period February-June 2011. Surveyed countries are: Australia, Belgium, Brazil, Canada, Denmark, France, Germany, India, Italy, Japan, Netherlands, Spain, Sweden, Switzerland, United Kingdom, United States.

In order to construct the sample, we selected all journals classified by ISI as belonging to one of the four disciplinary fields and sorted them by Impact Factor for all subfields of the four disciplines. Impact Factor was taken from the latest available release of the Journal Citation Report of Thomson-Web of Science®. We then randomly picked a selection of journals in each quartile of the Impact Factor distribution in each subfield of the four disciplines. In the aggregate, this selection corresponds to approximately 30% of all journals published in the four fields.

We downloaded full references of all scientific articles published in the selected journals in 2009 and retrieved the email address of the corresponding author. In case of multiple corresponding authors, we picked the first name on the list. In the case of corresponding authors appearing repeatedly in the list, we randomly selected one record[13]. The main language of the survey is English. However, the questionnaire and the invitation emails were available in six other languages: French, German, Italian, Japanese, Portuguese and Spanish. The online questionnaire was developed through the platform Qualtrics®. Each respondent received a customised questionnaire, in the sense that some questions were making direct reference to the title, year and journal of the person's own article included in the sample.

Therefore, the final dataset contains information on the specific article selected by the sampling criteria as well as information on background characteristics of the corresponding author.

Concerning the specific article, in addition to standard bibliometric data, we have information on the composition of the network of co-authors, whether the article involved an international collaboration, a set of reported characteristics of the topic that it addresses (e.g. whether it is in an emerging or multidisciplinary field and whether it is in a main research area for the author).

Concerning the corresponding author, the structure of the dataset allows us to control for a number of individual characteristics, including age, gender, job position, type of affiliation, international mobility data (including country of origin, reasons for leaving the origin country, periods of education or work abroad) and type of initial entry in the host country (for PhD training, post-doc, direct employment).

In the two following sub-sections we present our aggregated statistics on mobility patterns and on the relationship between mobility and research networks.

2.2 International mobility patterns

In this section we report summary statistics on the mobility for the 16 core countries. Country of origin was determined by asking the corresponding author to report country of residence at age 18. Data for the 17,182 scientists for whom country of origin and country of residence in 2011 could be determined are summarized in the left hand panel of the table 1 and show considerable variation in the percent foreign working or studying in country. Switzerland heads the list. More than one out of two scientists studying or working in Switzerland in 2011 lived

[13] In the four selected fields 95 percent or more of all articles contain an email address for the corresponding author. More specifically, in 2009 the estimated number of records that did not report email address for corresponding author was 0.9% in biology, 3.6% in chemistry, 2.9% in earth and environmental sciences and 4.5% in materials science.

abroad at age 18. Canada is a distant second, being 9.8 percentage points lower, followed closely by Australia (44.5 percent), and then by the United States with 38.4 percent and Sweden with 37.6. A number of countries have an extremely low percent of foreign scientists studying or working in the country. Particularly notable is the virtual absence of foreign scientists studying or working in India, followed closely by Italy with 3.0 percent, Japan with 5.0 percent, Brazil with 7.1 percent and Spain with 7.3 percent.

Table 1 Mobility patterns of surveyed scientists by country of work or study in 2011 and by country of residence at age 18.

COUNTRY OF WORK OR STUDY IN 2011 Obs. 17182 (number)	Share outside country at 18 %	Countries supplying 10% or more of foreign workforce (%)	Four country concentration rate %	COUNTRY OF ORIGIN AT AGE 18 Obs. 15115 (number)	Share currently outside the country %	Destination countries with more than 10% of natives abroad (%)
Australia (629)	44.5	UK (21.1) China (12.5)	43.6	**Australia (418)**	18.3	U.S. (45.8) UK (24.7)
Belgium (253)	18.2	Germany (15.2) France (15.2) Italy (13.0)	52.2	**Belgium (261)**	21.7	France (30.0) U.S. (20.0) UK (10.2)
Brazil (702)	7.1	Argentina (16.0) France (14.0) Columbia (12.0) Peru (12.0)	54.0	**Brazil (700)**	8.3	U.S. (34.0) Canada (15.7) Germany (15.5)
Canada (902)	46.9	UK (13.5) U.S (13.5) China (10.9)	43.5	**Canada (613)**	23.7	U.S. (70.1)
Denmark (206)	21.8	Germany (24.4)	44.5	**Denmark (183)**	13.3	UK. (37.5) U.S. (36.4)
France (1380)	17.3	Italy (13.8)	37.2	**France (1303)**	13.2	U.S. (22.8) UK (14.5) Canada (14.0)
Germany (1187)	23.2	None	30.2	**Germany (1254)**	23.3	U.S. (29.5) Switzerland (19.1) UK (18.0)
India (525)	0.8	*	100	**India (806)**	39.8	U.S. (75.1)
Italy (1792)	3.0	France (13.0) Germany (11.1) Spain (11.1)	42.6	**Italy (1938)**	16.2	U.S. (25.0) UK (19.7) France (15.5) Germany (10.7)
Japan (1707)	5.0	China (33.7) South Korea (11.6)	60.5	**Japan (1676)**	3.1	U.S. (51.4)
Netherlands (347)	27.7	Germany (14.6) Italy (12.5)	40.6	**Netherlands (339)**	26.4	U.S. (22.9) UK (19.5) Germany (18.8)

** data are not reported for China due to small numbers.*

Table 1 Mobility patterns of surveyed scientists by country of work or study in 2011 and by country of residence at age 18. (Continued)

COUNTRY OF WORK OR STUDY IN 2011 Obs. 17182 (number)	Share outside country at 18 %	Countries supplying 10% or more of foreign workforce (%)	Four country concentration rate %	COUNTRY OF ORIGIN AT AGE 18 Obs. 15115 (number)	Share currently outside the country %	Destination countries with more than 10% of natives abroad (%)
Spain (1185)	7.3	Argentina (12.6) France (10.3) Italy (10.3)	40.2	**Spain (1175)**	8.4	U.S. (31.0) Germany (16.2) UK (15.5) France (14.1)
Sweden (314)	37.6	Germany (11.9) Russian Fed. (10.2)	34.7	**Sweden (226)**	13.9	U.S. (23.8) UK (13.8) Germany (11.5)
Switzerland (330)	56.7	Germany (36.9)	59.4	**Switzerland (209)**	33.1	US (34.2) Germany (29.5)
UK (1205)	32.9	Germany (15.2) Italy (10.4)	37.6	**UK (1090)**	25.1	U.S. (46.9) Canada (16.6) Australia (16.6)
U.S. (4518)	38.4	China (16.9) India (12.3)	42.9	**U.S. (2924)**	5.0	Canada (32.2) UK (16.3) Australia (10.1) Germany (10.0)

Countries also vary in the degree of diversity of immigrants who work in country, measured by the percentage of immigrant researchers from the top-four source countries (four-country concentration rate, column 4). High concentration rates indicate less diversity. Switzerland, which shows the highest incidence of foreign born has also a very high concentration of inflows due to the substantial migration of researchers from Germany. Other countries, like the UK, show a more diversified composition of source countries.

The survey provides also information on scientists living in a core country at age 18 who were working or studying in one of the other 15 core countries in 2011 (right hand panel of the table). We again find considerable variation in the percent studying or working abroad. Not surprisingly, India heads the list with 39.8 percent of the scientists who lived there at age 18 working or studying outside the country in 2011. But the country that has the second highest rate among the 16 is Switzerland, with approximately one third of its residents studying or working abroad in 2011. The Netherlands and the UK are next, with approximately one in four of their residents studying or working outside of country. The country with the lowest percent of emigrants is Japan (3.1 percent) but the United States is close behind at 5.0 percent, followed by Brazil and Spain. There is considerably less variation in the country of destination (column 7). Indeed, the top destination country for emigrants from 13 of 15 countries is the United States; for the remaining two the United States is the second most likely destination country. The most likely destination country for individuals living in the United States at age 18 is Canada.

The above reported aggregated statistics at the country level are computed using all collected observations for which information regarding country of origin and country of residence in 2011 was available. In the following summary statistics and in the subsequent econometric analysis we focus exclusively on the subset of surveyed scientists working in academia or at a public research institution at the time of the survey, dropping respondents whose main affiliation in 2011 was in a company (about 2.5% of the sample).

2.3 Mobility and the scope of international research networks

The last three decades have witnessed an increase in the extent of international scientific cooperation (Wagner and Leydesdorff, 2005). Numerous factors have been noted as contributing to the trend, from policy "push" initiatives (European Commission, 2005) to the advancement of technological solutions for remote collaborations (Ding et al. 2010). Here we investigate the specific link between international mobility and the establishment of international research networks.

In the analysis that follows, surveyed researchers have been classified into one of three possible mobility statuses with respect to her/his country of residence in year 2011: i) foreign born (24.3% of the sample); ii) returnee after a period abroad for either a PhD, a post-doc or a period of employment (29.7%); iii) non-mobile (46.0%).

Based on the survey data, we derive an indication concerning the individual's propensity to have an international research network using two alternative types of information: i) the characteristics of the specific paper that have been investigated in the survey; ii) the number of countries with which the scientist has collaborated in the last two years. Respondents directly declare the latter information in the questionnaire.

Table 2 provides information regarding the incidence of researchers who are corresponding authors of a paper with one or more international coauthors, by mobility status. The data show that about 24% of the articles in our dataset involved an international collaboration with some variance across the four disciplines. In all fields the incidence of internationally co-authored papers is lower for non-mobile researchers. Note that these summary statistics do not account for additional factors (e.g. age, type of affiliation, country of origin and residence) that are likely to affect the propensity to engage in international collaboration. We will address such factors in detail in the section devoted to the econometric analyses.

Table 2 Incidence of internationally co-authored papers by scientific field and mobility status of corresponding author.

	Incidence of international collaborations				
	All fields	Biology	Chemistry	Earth Science	Material Science
Full Sample	23.94%	25.30%	23.61%	33.17%	22.82%
Foreign born	33.59%	30.52%	31.66%	42.68%	30.01%
Returnees	29.12%	28.85%	26.38%	43.23%	24.18%
Non Mobile	20.26%	20.41%	17.88%	24.74%	18.15%

Table 3 presents self-reported data concerning the number of international collaborations the respondent has had in the past two years. We see that non-mobile researchers show on average the higheest incidence of no international collaboration or minimal international collaboration (with 1 country). Conversely, both foreign-born and returnees show always the highest incidence of collaboration with two or more countries. Interestingly, more than 12% of the sample consists of scientists who collaborated in the last two years with colleagues located in 6 or more different countries. Clearly, such patterns are likely affected by field specificities that will be accounted for in the econometric section.

Table 3 Mobility status and the scope of international research networks. Number of foreign countries the author has collaborated with in the last 2 years.

	International network size (% of respondents)			
	Full Sample	Foreign born	Returnees	Non Mobile
No international collaborations	19.08	14.06	14.26	24.36
1 country	18.71	17.59	17.28	19.91
2 countries	19.64	20.98	20.17	18.92
3 countries	15.01	15.89	16.45	13.73
4 countries	9.04	10.66	10.40	7.37
5 countries	6.27	6.90	7.68	5.12
6 to 10 countries	9.77	11.23	11.09	8.38
11 or more other countries	2.49	2.69	2.68	2.22

In order to further investigate the link between international collaboration and international mobility, we present data in the table 4 concerning the incidence, by country of current work or study, of foreign born who declare having a research collaboration with their country of origin. The incidence is computed first by considering collaboration irrespective of countries of origin (column A), and then only for collaborations with the countries of origin of foreign-nationals of countries that were not surveyed (non-core origin countries – column B). By way of example, 46.1% of foreign born researchers in Australia report that they have an international collaboration with someone in their home country. Of these, 42.6% of natives from non-core countries report collaboration with their country of origin. Interestingly, on average slightly more than 40% of foreign-born researchers declare to have ongoing research collaborations with their countries of origin. The incidence of collaboration with the origin country tends to decrease when we focus exclusively on foreign born researchers from non-core countries (column B). There are, however, important variations: in the case of US, which attracts a large number of researchers from China and India, we observe a relatively smaller reduction in the percentage when we restrict the analysis to foreign natives of non-core countries only.

Table 4 Incidence of foreign born researchers that report collaboration with other researchers based in their country of origin, by country of work or study in year 2011.

	Incidence of foreign born researchers collaborating with their origin country (% of foreign-born)	
Current country	A) From any origin country	B) From Non-core origin countries*
Australia	46.1	42.6
Belgium	55.6	16.7
Brazil	29.3	34.5
Canada	35.8	27.5
Denmark	33.3	27.3
France	57.7	48.9
Germany	39.0	35.7
Italy	56.8	63.2
Japan	43.5	39.6
Netherlands	53.4	40.0
Spain	38.0	28.6
Sweden	56.7	44.7
Switzerland	50.3	39.3
UK	44.0	34.0
USA	37.4	35.1
TOT	41.7	35.9

* In this statistic non-core countries include also India.

Table 5 reports summary statistics from our sample of mobile researchers regarding the perceived impact of their international mobility experience. We see that on average, both returnees and foreign born researchers assign the highest average value to the item “enlarging my research network”, followed by “learning new techniques / theories”. This is consistent with the hypothesis that international mobility has a non-negligible impact on the international openness of the research systems of both source and destination countries. Notably, other items related to economic and pecuniary benefits from international mobility receive on average lower ratings. The latter evidence suggests that high-skilled migration patterns – at least in the specific case of scientific careers - cannot be fully captured by underlying theoretical models that predict mobility primarily on the basis of wage differentials. This is also reflected in the reasons reported by mobile researchers concerning their decision to move back to their country of origin. Among a number of different items from which the respondent could choose, the prevailing factors for moving are related to personal or family reasons rather than economic factors or career prospects in the country of origin.

Table 5 The perceived impact of international mobility for returnees and foreign born.

1-5 Scale: Totally unimportant (1) - Extremely important (5).

	Returnees	Foreign born
Enlarging my research network	4.19	4.35
Establishing a stable research cooperation with teams/scholars located abroad	3.71	4.02
Entering into new fields of research	3.90	4.08
Learning new techniques/ theories	4.12	4.17
Improving my capability to publish in high-tiers journals	3.68	3.93
Improving my wage and earning possibilities	2.72	3.41
Improving my career prospects	3.89	4.08
Establishing better contacts with industrial partners	2.15	2.67
Improving my ability to raise research funds	3.16	3.65

3. ECONOMETRIC ANALYSES

This section provides a set of econometric models that investigate the presence of significant correlations at the individual level between international mobility and the scope and quality of international research networks. We assess such relationship controlling for researchers background, scientific fields characteristics and country of residence.

We perform two analyses to assess the degree to which international mobility of researchers is associated to international collaboration. First, we look at the correlation between the mobility status of the respondent and the likelihood that the associated paper, i.e. the paper authored by the respondent and drawn to be included in the survey sample, is internationally-coauthored. For this purpose we have created the dummy variable named INTER that equals one for those articles in our sample that have an international network of co-authors. Second, we analyse the correlation between mobility status and the scope of the respondent's international research network, captured by whether the respondent reported collaborating with individuals outside the current country of work or study in the past 2 years. To be more specific, we generated the dummy variable NETWORK that equals one for those authors in our sample who declare having a large international research network, i.e. with collaborations in more than 4 countries in the last 2 years.

In our models we account for the following article-specific variables: number of co-authors (SIZE), whether the author reports the article to be in her/his main research area on a 1-5 scale (CORE_PROJ), the quality of the scientific article proxied by the impact factor of the related journal in 2009 (IF)[14]. In terms of author-specific variables, we account for: age (AGE), a dummy variable for gender (FEMALE), a dummy variable for whether the respondent has a job position that allows full research independence, i.e. professorship or staff scientist (INDEPENDENT), two

[14] The distributions of journals' impact factors show significant differences across scientific fields. In order to control for this effect in our model specification we have always included field dummy variables. As a robustness control we have also run all the presented models using a normalised version of the journal impact factors. The rank-normalized Impact Factor (RNIF) is an algebraic indicator based on the journal Impact Factor in which the article appeared that is useful to compare the impact of journals of different disciplines (Pudovkin and Garfield, 2004). The RNIF is calculated with the following formula:

$$RNIF_j = (K - R_j + 1)/K$$

where Rj is the Journal of Citation Report (JCR) rank of journal j and K is the number of journals in its subject discipline. By construction, the RNIF ranges between 0 and 1. Results are robust to adoption of this alternative measure of quality.

dummy variables for the mobility status (FOREIGN BORN, RETURNED), a dummy variable that values one for those foreign born researchers who have received their PhD in the destination country (PHD_INCOMING). Table 6 provides the summary statistics of the variables used in the econometric models. In the analyses we also include several full sets of control dummies: 16 country dummies that control for the baseline distribution in the core-country of residence of the respondents in 2011; 4 field dummies; 3 institution dummies (university, public research centre, other non-profit institutions).

Table 6 summary statistics of variables used in the econometric analyses

Variable	Mean	Median	St dev	1st cent	99th cent
FOREIGN BORN	0.225	0	0.438	0	1
RETURNED	0.299	0	0.458	0	1
PHD_INCOMING	0.406	0	0.491	0	1
SIZE	4.932	4	2.893	1	15
CORE_PROJ	4.195	4.5	0.909	1.4	5
INDEPENDENT	0.622	1	0.484	0	1
AGE	48.100	47	10.87	29	75
FEMALE	0.239	0	0.426	0	1
NETWORK	0.276	0	0.447	0	1
INTERN	0.259	0	0.438	0	1
IF	2.887	3.789	23.431	0.424	16.826

In all the econometric models presented in the following sections we have adopted a standard approach which consists of dropping observations for which we were not able to collect all the required information in the survey. Because such a procedure might generate possible biases in the estimates, to check for robustness we present additional models in which we account for missing data[15] and introduce country-level weights that account for the variations in response rates across countries in Appendix B.

3.1 Mobility and international research network

Table 7 presents estimates from a probit model testing for the presence of significant correlations at the individual level between the mobility status and the international co-authorship of the associated article. In model I we show the baseline specification while in models II – IV we test for the additional impact exerted by the mobility status of the author. The article-level controls, as expected, indicate in all models a positive effect of team size on the likelihood of observing an international collaboration. International collaborations appear to be more frequent among those articles that are in a main area of research interest of the author. Even after controlling for field and country dummies we observe that females are less likely to engage in international collaboration. On average older researcher are more likely to be involved in international collaborations.

The introduction of the mobility variables in model II and III reveals a positive and significant impact of both the foreign-born and the returnee variable. In model IV, we compare mobile researchers (either foreign-born or returnees) to non-mobile researchers working in the same country and scientific field. Results confirm that - net of individual and article specific effects - mobile researchers do have on average a higher propensity to be involved in international collaborations. The table reports coefficients from the probit estimates. The computation of marginal effects at covariates' sample mean for model IV indicate that being a foreign born generate an increase, all else equal, of 13.8 percentage points in the likelihood of having an international collaboration. The marginal effects for the RETURNED

[15] In particular some individual characteristics used in the econometric models (e.g. age and gender) were asked at the end of the questionnaire. As a result, there are 880 missing entries for gender and 1034 missing entries for age, mostly due to respondent dropouts. We applied a methodology for the imputation of these missing data (see Little and Rubin, 2002). Results fully confirm the evidence reported in this section of the paper.

variable in model IV is 7.4 %. In model IV the estimated coefficient for the FOREIGN BORN variable is significantly higher (99% confidence level) than the coefficient for the RETURNED variable.

Table 7 Probit model. Dependent variable (INTER) equals 1 for papers with international collaborations.

Models	I	II	III	IV
FOREIG BORN		0.335***		0.421***
		(0.030)		(0.032)
RETURNED			0.110***	0.236***
			(0.027)	(0.029)
SIZE	0.194***	0.193***	0.194***	0.193***
	(0.008)	(0.008)	(0.008)	(0.008)
SIZESQ	-0.005***	-0.004***	-0.005***	-0.004***
	(0.000)	(0.000)	(0.000)	(0.000)
CORE_PROJ	0.062***	0.059***	0.062***	0.058***
	(0.013)	(0.013)	(0.013)	(0.013)
AGE	0.002*	0.003***	0.002	0.003**
	(0.001)	(0.001)	(0.001)	(0.001)
INDEPENDENT	0.019	0.0386	0.006	0.016
	(0.032)	(0.032)	(0.032)	(0.032)
FEMALE	-0.106***	-0.103***	-0.101***	-0.093***
	(0.029)	(0.029)	(0.029)	0.421***
Institution dummy	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes
Field dummies	Yes	Yes	Yes	Yes
Constant	-2.179***	-2.388***	-2.154***	-2.391***
	(0.108)	(0.110)	(0.108)	(0.110)
Observations	14464	14464	14464	14464
Pseudo R-sq	0.0976	0.1051	0.0986	0.1090
Log Lik	-7392.4	-7331.5	-7384.5	-7299.1
Chi-Sq	1599.8***	1721.7***	1615.8***	1786.5***

*Standard errors in parentheses. Significant at *,**,***: 90% ,95%, 99%.*

The models presented in Table 8 further analyse the relationship between mobility status and international collaboration by focussing directly on the reported scope of the international research network of each respondent. We have set the dummy dependent variable equal to one for those authors who declare having collaborated with individuals in more than 4 countries in the past two years[16]. Using this indicator of international openness we find a significant positive effect of the international mobility variables (models II-IV in Table 8), confirming the previous results presented in Table 7 that were based on the incidence of international co-authorships in the associated papers. Note that for this set of estimates the number of available observation increases because of the presence of incomplete answers for article-specific questions used in the previous probit models (Table 7). As expected, in all model specifications both age and the variable capturing job independence have a positive significant effect on the scope of the international research network.

[16] On average in our sample this amounts to about one third of surveyed researchers. As a robustness control we have also run alternative probit model specifications using slightly higher and lower thresholds for the definition of a large international network and ordered probit models. The main results about the impact of mobility presented in this paper are confirmed.

Table 8 Probit model. Dependent variable (NETWORK) equals one for those researchers that have declared of having a large international research network.

MODELS	I	II	III	IV
FOREIGN BORN		0.194***		0.255***
		(0.029)		(0.031)
RETURNED			0.090***	0.167***
			(0.026)	(0.028)
AGE	0.008***	0.009***	0.008***	0.009***
	(0.001)	(0.001)	(0.001)	(0.001)
INDEPENDENT	0.302***	0.312***	0.291***	0.296***
	(0.032)	(0.032)	(0.032)	(0.032)
FEMALE	-0.213***	-0.212***	-0.209***	-0.205***
	(0.028)	(0.028)	(0.028)	(0.028)
Institution dummy	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes
Field dummies	Yes	Yes	Yes	Yes
Constant	-1.519***	-1.640***	-1.500***	-1.645***
	(0.084)	(0.086)	(0.084)	(0.086)
Observations	15115	15115	15115	15115
Pseudo R-sq	0.104	0.106	0.104	0.108
Log Lik	-7978.2	-7956.2	-7972.4	-7938.7
Chi sq	1849.8***	1893.6***	1861.3***	1928.7***

*Standard errors in parentheses. Significant at *,**,***: 90% ,95%, 99%.*

3.2 Mobility and the quality of internationally co-authored papers

In this section we analyse whether the higher propensity to have international collaborations for mobile researchers is also associated with significant differences in the average quality of internationally co-authored papers. The level of scientific relevance of analysed articles is measured by the impact factor of the related scientific journal in year 2009. In all model specifications we keep field dummies in order to control for the baseline distribution of impact factors among the journals of a specific field. We restrict this analysis to internationally-coauthored papers only, to avoid spurious effects due to a possible average positive correlation between quality and international collaborative papers.

Following previous research regarding the determinants of researchers' scientific output, in this set of models we include both age and age square among individual controls. In the baseline model specification (model I in Table 9) we obtain a positive effect with diminishing returns of research team size and age of the respondent. Job seniority – net of age effects - is also positively associated to research output quality. The data reveal that internationally co-authored papers with a mobile corresponding author tend to have on average a higher impact factor than those with a non-mobile corresponding author (model IV). Although we are well aware that the impact factor is but a partial measure of the actual scientific relevance of articles, the results suggest that the previous observed higher propensity of mobile researcher to collaborate across borders is not associated with a lower quality of research performance.

Table 9 OLS model. Dependent variable is the impact factor of the surveyed publication. The sample includes only internationally co-authored papers.

Models	I	II	III	IV
FOREIG BORN		0.280**		0.563***
		(0.130)		(0.142)
RETURNED			0.414***	0.632***
			(0.120)	(0.132)
SIZE	0.334***	0.335***	0.335***	0.337***
	(0.034)	(0.034)	(0.033)	(0.033)
SIZESQ	-0.005***	-0.005***	-0.005***	-0.005***
	(0.001)	(0.001)	(0.001)	(0.001)
CORE_PROJ	0.414***	0.408***	0.414***	0.402***
	(0.062)	(0.062)	(0.062)	(0.062)
AGE	0.107***	0.107***	0.101**	0.096**
	(0.040)	(0.040)	(0.040)	(0.040)
AGESQ	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
INDEPENDENT	0.667***	0.683***	0.622***	0.630***
	(0.145)	(0.146)	(0.146)	(0.146)
FEMALE	-0.345***	-0.345***	-0.328**	-0.319**
	(0.130)	(0.130)	(0.130)	(0.130)

Institution type dummy	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes
Field dummies	Yes	Yes	Yes	Yes
Constant	-2.793**	-2.829**	-2.819**	-2.905**
	(1.133)	(1.132)	(1.131)	(1.129)
Observations	3,670	3,670	3,670	3,670
R-squared	0.189	0.190	0.192	0.196
Adj. R-sq	0.183	0.184	0.186	0.189
F stat	31.535***	30.606***	30.922***	30.515***

*Standard errors in parentheses. Significant at *,**,***: 90% ,95%, 99%.*

3.3 The effects of country of training and of destination countries of mobile researchers.

In this section we show a set of model specifications aimed at disentangling potential different determinants underlying the observed evidence on mobility, international collaboration propensity and quality of related papers. The previously estimated superior performance of the subsample of foreign born researchers with respect to other researchers in the same country and research field might be due to an ex-ante selection of immigrants. In order to test this effect we now include in the model specifications a variable that equals one for those foreign born who received their PhD in the destination country (PHD_INCOMING). The analysed sample includes all the researchers in each core country. The idea behind this variable is that foreign born who have been trained in the destination country should have a more limited "international" advantage (e.g. no previous research networks abroad established during his training and research career) than the foreign born who trained outside the country. Thus, PHD_INCOMING should exert a moderating effect on the FOREIGN BORN variable.

Table 10 presents the results for this modelling structure for international collaboration propensity (model I and II) and for research quality (model III). The estimates indicate that the variable PHD_INCOMING has indeed a negative and significant effect on all three of the measures. However, its moderating impact is different across the model specifications. In the case of research quality (model III) the PHD_INCOMING dummy variable nearly fully offsets the FOREIGN BORN dummy variable. This suggest that foreign born who received their PhD in the destination country do not show a significantly higher performance than the average local researcher in the same field. The moderating effect of the PhD variable turns out to be relatively small in magnitude but significant in the case of international collaborations. These results suggest that the aggregated "foreigner premium" effects is driven mostly by mobile researchers with a previous training or work experience outside of the destination country, i.e. by individuals who had likely formed their research.network prior to entering the destination country. Immigrants for a post-doc represent a clear example of this typology of researchers. The ex-ante selection process is likely to be more binding for post-docs or for migrant researchers directly employed by universities or public research centres in the destination country, rather than for PhD candidates. In this regard our evidence is in line with other recent contributions that have pointed out the relevance of temporary international mobility (Edler et al. 2011).

Table 10 Testing the moderating effect of PhD in the destination country. Model I: probit model with dependent variable NETWORK; Model II: probit model with dependent variable INTERN; model III OLS model with dependent variable IF.

Models	I Large Network	II Internationally-coauthored paper	III IF of internationally co-authored papers
FOREIG BORN	0.259***	0.368***	0.413***
	(0.035)	(0.036)	(0.151)
PHD_INCOMING	-0.164***	-0.081*	-0.359*
	(0.048)	(0.049)	(0.207)
SIZE		0.193***	0.334***
		(0.008)	(0.034)
SIZESQ		-0.004***	-0.005***
		(0.000)	(0.001)
CORE_PROJ		0.059***	0.410***
		(0.013)	(0.062)
AGE	0.009***	0.003***	0.106***
	(0.001)	(0.001)	(0.040)
AGESQ			-0.001***
			(0.000)
INDEPENDENT	0.310***	0.037	0.676***
	(0.032)	(0.032)	(0.146)
FEMALE	-0.212***	-0.103***	-0.347***
	(0.028)	(0.029)	(0.130)
Institution type dummy	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes
Field dummies	Yes	Yes	Yes
Constant	-1.626***	-1.349***	-2.804**
	(0.086)	(0.085)	(1.132)
Observations	15115	14464	3670
Adj. R-squared	--	--	0.191
Pseudo R-sq	0.107	0.105	0.185
Log	-7950.560	-7330.186	--
Chi-Sq	1905.0***	1724.4***	--

*Standard errors in parentheses. Significant at *,**,***: 90% ,95%, 99%.*

The average estimated differentials between non mobile researchers, foreign born and returnees in collaboration propensity might be affected by the specific conditions of the destination country, such as the strength of the national research base. In previous model specifications (sect. 3.1) we have controlled for this effect by introducing destination country dummies. Here we further explore the potential differentials of destination countries by estimating separate models for different pools of countries. In order to have sufficiently large sub-samples, we have split the core countries in the three following groups: US, European countries, other countries. In the table 11 we report the estimated results for selected models. Evidence suggests that the mobility effects on the international network variables persist across the subgroups and that our previous results are not fully driven by a specific subset of destination countries. On the contrary, when we estimate the models that regress the impact factor of the internationally co-authored papers against individual's characteristics we find that mobility status matters only for countries other than the US (Table 12). Although the robustness of the latter set of estimates might suffer from a significant reduction in observations, results seem to suggests that for the US the foreign born and the returnees tend to have a higher propensity to establish international collaborations, but the outcomes of related research is no statistically different to that of non mobile researchers in the same field.

Table 11 Probit models. Models I-III: dependent variable NETWORK; Models IV-VI: dependent variable INTER.

	Large network			Internationally-coauthored paper		
	I USA	II EUROPEAN COUNTRIES	III OTHER COUNTRIES	IV USA	V EUROPEAN COUNTRIES	VI OTHER COUNTRIES
FOREIG BORN	0.207***	0.291***	0.240***	0.412***	0.409***	0.493***
	(0.053)	(0.045)	(0.077)	(0.054)	(0.048)	(0.078)
RETURNED	0.188**	0.141***	0.211***	0.418***	0.189***	0.263***
	(0.083)	(0.035)	(0.061)	(0.085)	(0.038)	(0.060)
SIZE				0.238***	0.180***	0.298***
				(0.023)	(0.010)	(0.028)
SIZESQ				-0.007***	-0.004***	-0.011***
				(0.001)	(0.000)	(0.002)
CORE_PROJ				0.058**	0.055***	0.060**
				(0.029)	(0.018)	(0.029)
AGE	0.013***	0.005***	0.011***	0.008***	0.002	-0.002
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)
INDEPENDENT	0.155**	0.348***	0.277***	-0.245***	0.063	0.113
	(0.076)	(0.040)	(0.081)	(0.073)	(0.042)	(0.078)
FEMALE	-0.226***	-0.207***	-0.195***	-0.111*	-0.097***	-0.056
	(0.063)	(0.035)	(0.073)	(0.063)	(0.037)	(0.069)
Institution dummy	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies	No	Yes	Yes	No	Yes	Yes
Field dummies	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-1.722***	-0.649***	-2.337***	-2.502***	-1.920***	-2.681***
	(0.181)	(0.112)	(0.193)	(0.232)	(0.147)	(0.242)
Observations	3,939	7,301	3,875	3,779	7,007	3,678
Pseudo R-sq	0.039	0.049	0.1020	0.101	0.083	0.105
Log Lik	-1733.2	-4649.6	-1535.8	-1601.2	-4049.0	-1618.3
Chi-Sq	141.9	486.5827	348.9375	362.6405	736.9881	380.7782

*Standard errors in parentheses. Significant at *,**,***: 90% ,95%, 99%.*

Tab 12 OLS model. Dependent variable is the impact factor of the surveyed publication. The sample includes only internationally co-authored papers.

	I USA	II EUROPEAN COUNTRIES	III OTHER COUNTRIES
	IF of the internationally-coauthored paper		
FOREIG BORN	-0.321	0.944***	0.639*
	(0.322)	(0.182)	(0.339)
RETURNED	-0.590	0.827***	0.962***
	(0.476)	(0.154)	(0.286)
SIZE	0.291**	0.332***	0.055
	(0.136)	(0.038)	(0.121)
SIZESQ	0.001	-0.006***	0.011
	(0.007)	(0.001)	(0.007)
CORE_PROJ	0.449***	0.366***	0.509***
	(0.169)	(0.074)	(0.134)
AGE	-0.068	0.146***	0.086
	(0.099)	(0.050)	(0.090)
AGESQ	0.000	-0.002***	-0.001
	(0.001)	(0.000)	(0.001)
INDEPENDENT	0.941**	0.663***	0.068
	(0.445)	(0.167)	(0.354)
FEMALE	-0.895**	-0.186	-0.358
	(0.377)	(0.151)	(0.310)
Institution dummy	Yes	Yes	Yes
Country dummies	No	Yes	Yes
Field dummies	Yes	Yes	Yes
Constant	4.468*	-3.646***	-1.440
	(2.628)	(1.342)	(2.376)
Observations	681	2276	713
Adj. R-sq	0.2087	0.1808	0.1731
F stat	13.809	22.824	9.277

*Standard errors in parentheses. Significant at *,**,***: 90% ,95%, 99%.*

4. CONCLUSION

This paper contributes to the existing evidence on international mobility of researchers working in four scientific fields, presenting results from the GlobSci survey that collected detailed data on the mobility and scientific collaborations of more than 19,000 researchers working or studying in 16 countries in 2011. With respect to previous country-specific analyses, the homogeneity of the administered survey allows for direct comparisons across countries of inflow and outflow patterns of high-skilled people involved in scientific research. Our summary evidence confirms the absolute relevance of the migration phenomenon for most of the advanced economies. More than 40% of the researchers sampled in the four fields in Switzerland, Canada and Australia are immigrants. The phenomenon is non-negligible for the US and for some other European economies such as UK, Netherlands, Germany and Sweden. It is also notable that on average about 40% of foreign-born scientists in our sample reports having kept research links with their country of origin, suggesting the presence of significant knowledge spillovers between source and destination countries. Our results also are consistent with the hypothesis that internationally mobile researchers significantly contribute to extending the international scope of the research network of destination countries, at no detriment of research output quality. All else equal, being a foreign-born increases of 13.8 percentage points the likelihood of having an international collaboration and being a native with experience of work or study abroad increases the likelihood of 7.4 percentage points. Moreover, our results suggest that the "foreigner premium" on collaboration propensity and research quality is driven mostly by mobile researchers who have previous training or work experience outside of the destination country where they were surveyed in 2011, as opposed to those who trained in the same country of destination.

References

Auriol, L. (2010) "Careers of Doctorate holders: employment and mobility patterns" OECD STI Working paper 2010/4

Allison, P. (2001) "Missing data" SAGE University Press

Bozeman, B., Corley, E. (2004), 'Scientists' collaboration strategies: implications for scientific and human capital, *Research Policy,* 33 **:** 599–616.

Cañibano, C., F.J. Otamendi and F. Solís (2011) International temporary mobility of researchers: a cross-discipline study, *Scientometrics*, 89: 653-67.

Ding, W., Levin, S., Stephan, P., Winkler, A. (2010) "The Impact of Information Technology on Academic Scientists' Productivity and Collaboration Patterns" *Management Science* vol. 56 no. 9 1439-1461

Edler, J., Fier, H., & Grimpe, C. (2011). International scientist mobility and the locus of knowledge and technology transfer. *Research Policy*, 40, 791–805.

Empirica GmbH (2005) "Post-Docs in the Life Science" Paper prepared for the NetReAct project. Dowloadable at: www.netreact-eu.org/documents/NetreactDeliverable1.3.pdf

Filippo, D., Casado, E., & Gomez, S. (2009). Quantitative and qualitative approaches to the study of mobility and scientific performance: A case study of a Spanish university. *Research Evaluation*,18(3),191–200.

Franzoni, C., Scellato, G., Stephan, P. (2011). "Changing incentives to publish" *Science*, Vol. 333 no. 6043 pp. 702-703.

Franzoni, C., Scellato, G., Stephan, P. (2012). Foreign Born Scientists: Mobility Patterns for Sixteen Countries, mimeo.

Freeman, R.B., 2010. Gobalization of scientific and engineering talent: International mobility of students, workers, and ideas and the world economy. *Economics of Innovation and New Technology* 19 (5), 398–406.

Haeussler, C. (2011) "Information-sharing in academia and the industry: A comparative study," Research Policy, 40(1), 105-122

Hunter, R. S., Oswald, A. J., & Charlton, B. G. (2009). The elite brain drain. *Economic Journal*, 119(538),

Jonkers, K. and R. Tijssen (2008) Chinese researchers returning home: impacts of international mobility on research collaboration and scientific productivity, *Scientometrics*, 77 (2): 309-333.

Jöns, H. (2009) 'Brain circulation' and transnational knowledge networks: studying long-term effects of academic mobility to Germany, 1954–2000, *Global Networks*, 9(3): 315–338.

Laudel, G. (2003) "Studying the brain drain: can bibliometric methods help? " *Scientometrics*, vol. 57(2), pp. 215–37.

Laudel, G. (2005). Migration currents among the scientific elite', Minerva, vol. 43(4), pp. 377–95.

Levin, Sharon and Paula Stephan. (1999). "Are the Foreign Born a Source of Strength for U.S. Science?" Science 285:1213-14.

Little, R., Rubin, D. (2002). Statistical analysis with missing data. New York: John Wiley & Sons.

Melin, G. (2004) Postdoc abroad: inherited scientific contacts or establishment of new networks?, *Research Evaluation,* 13(2): 95-102.

Meyer, J. (2001), Network approach versus brain drain, lessons from the diaspora, *International Migration*, 39 **:** 91–110.

MORE Project (2010), funded by the European Commision (DG Research) (http://www.researchersmobility.eu)

National Science Board. (2012), Science and Engineering Indicators: 2012. Arlington, VA: National Science Foundation.

Pudovkin, A., Garfield, E. (2004). Rank-normalized impact factor: a way to compare journal performance across subject categories. Proceeding of the 67th ASIS&T Annual Meeting. Providence, RI, 41, 507-515.

Sauermann, H, Roach., M (2010) "Not all scientists pay to be scientists: Heterogeneous preferences for publishing in industrial research," Georgia Institue of Technology, working paper.

Saxenian, A. L. (2002). Brain circulation: How high skill immigration makes everyone better off. The Brookings Review, 20(1), 28–31.

Stephan, Paula (2012). How Economics Shapes Science, Cambridge, MA: Harvard University Press.

Stephan, P. E., & Levin, S. G. (2001). Exceptional contribution to US science by the foreign-born and foreign-educated. *Population Research and Policy Review*, 20(1–2), 59–79.

Wagner, C. S., Leydesdorff, L. (2005), Network structure, self-organization, and the growth of international collaboration in science, *Research Policy*, 34 **:** 1608–1618.

ANNEX A

Survey response rates

The following Table A1 reports the number of answers received by country. Answers are further divided into complete answers and partial answers. The latter are answers from respondents who began the survey, but dropped-out before reaching the last question. The total dropout rate is 5 percent. The response rate is 40.6 percent if both complete and partial answers are counted. Reported response rates do not take into account undelivered invitations due to such things as incorrect email address, retirement or death and consequently underestimate the response rate.

Table A1 response rates by country

	Panels	Total Answers	Of which complete	Of which dropout	Total Response Rate	Complete Response Rate
Australia	1,571	676	610	66	43.00%	38.80%
Belgium	706	302	244	58	42.80%	34.60%
Brazil	1,537	762	692	70	49.60%	45.00%
Canada	2,455	1,020	897	123	41.50%	36.50%
Denmark	513	227	208	19	44.20%	40.50%
France	3,839	1,618	1,367	251	42.10%	35.60%
Germany	4,380	1,326	1,147	179	30.30%	26.20%
India	1,380	627	484	143	45.40%	35.10%
Italy	2,779	1,917	1,759	158	69.00%	63.30%
Japan	5,250	1,860	1,678	182	35.40%	32.00%
Netherlands	1,036	391	345	46	37.70%	33.30%
Spain	2,303	1,228	1,080	148	53.30%	46.90%
Sweden	882	353	301	52	40.00%	34.10%
Switzerland	919	356	320	36	38.70%	34.80%
UK	3,695	1,355	1,183	172	36.70%	32.00%
U.S.	14,059	5,165	4,512	653	36.70%	32.10%
Total	**47,304**	**19,183**	**16,827**	**2,356**	**40.60%**	**35.60%**

Response rates by scientific field are reported in Table A2. Participation was highest for scientists in earth and environmental sciences and lowest for scientists in biology. Differences in country and discipline participation are likely to reflect in part the degree to which similar populations of scientists have been surveyed in the recent past by other, unrelated studies (Haeeussler, 2011; Sauermann and Roach 2011).

Table A2 response rates by field

	Panels	Total Answers	Of which complete	Of which dropouts	Total Response Rate	Complete Response Rate
Biology	**15,290**	5,810	5,097	713	38.00%	33.30%
Chemistry	**15,549**	6,324	5,524	800	40.70%	35.50%
Earth & Environment	**8,616**	3,956	3,532	424	45.90%	41.00%
Materials Science	**7,849**	3,093	2,674	419	39.40%	34.10%
Total	**47,304**	**19,183**	**16,827**	**2,356**	**40.60%**	**35.60%**

We have assessed non-response bias by comparing respondents against non-respondents. Comparison is done for two characteristics known for the entire panel and sample: total citations received by the underlying article and number of coauthors. Total citations are likely positively correlated with the eminence of the scientist and could potentially reflect differentials in the propensity to answer related to how busy the respondent is. Because the number of coauthors was a basis for a branching question in the survey, more coauthors meant that more questions were asked. Therefore, it is potentially associated with dropping out of the survey. Tests for equality of means are performed for each pair of country samples (Table A3). A relatively higher propensity to answer from authors with better-cited papers is found for France, Italy, Spain and the U.S. Authors of papers with more co-authors are also more likely to have answered from Brazil, Germany, Italy and the U.S. Thus, although there is some response bias, it is not in the direction that one might hypothesize.

Table A3 Non-response biases

		Total Cites	Number of authors
Australia	mean diff.	-0.039	0.035
	st.err.	0.098	0.142
Belgium	mean diff.	-0.268	-0.274
	st.err.	0.162	0.222
Brazil	mean diff.	0.088	0.397
	st.err.	0.046	0.125*
Canada	mean diff.	0.009	0.160
	st.err.	0.063	0.105
Denmark	mean diff.	-0.002	-0.114
	st.err.	0.224	0.242
France	mean diff.	0.122	0.029
	st.err.	0.058*	0.094
Germany	mean diff.	0.158	0.205
	st.err.	0.092	0.099*
India	mean diff.	0.029	0.008
	st.err.	0.052	0.096
Italy	mean diff.	0.181	0.288
	st.err.	0.061*	0.12*
Japan	mean diff.	0.089	0.112
	st.err.	0.052	0.080
Netherlands	mean diff.	0.069	0.031
	st.err.	0.124	0.178
Spain	mean diff.	0.161	0.051
	st.err.	0.064*	0.095
Sweden	mean diff.	-0.040	0.089
	st.err.	0.133	0.188
Switzerland	mean diff.	0.212	0.206
	st.err.	0.200	0.200
UK	mean diff.	0.143	0.123
	st.err.	0.083	0.108
U.S.	mean diff.	0.354	0.146
	st.err.	0.052*	0.049*

$^*p<0.05$

ANNEX B

Robustness controls: observations weights and missing values.

In this annex we present the results for selected model specifications in which we account for missing values and we use sample weights to account for differentials across countries in response rates. For a review of the statistical properties and implication of multiple imputation of missing data we refer to Little and Rubin (2002) and Allison (2001)

The standard steps involved in multiple imputation processes are the following (Allison, 2001) : i) impute missing values using an appropriate model that incorporates random variation; ii) repeat the previous step M times, producing M "complete" data sets; iii) Perform the statistical analyses on each data set using standard complete-data econometric techniques; iv) average the values of the parameter estimates across the M samples to produce a single point estimate; v) calculate the standard errors by averaging the squared standard errors of the M estimates and calculating the variance of the M parameter estimates across samples. Note that multiple imputation requires that the data must be missing at random (MAR), meaning that the probability of observing a missing data on a particular variable Y can depend on other observed variables, but not on Y itself (controlling for the other observed variables).

Concerning the imputation of missing values, we have imputed only the variables age and gender. The imputation procedure is based on the use of predicted values from a from a Logit model (for the FEMALE dummy variable) and of an OLS model (for AGE variable).

The specifications used in the imputation models include among covariates country of residence in 2011, foreign experience (PhD, postdoc and job), job position, affiliation type, the presence of secondary affiliations, field of research. The data have been treated using the Multiple Imputation routine of STATA 12. We have generated M=5 imputations for each missing value. Note that due to the application of the multiple imputation procedure, for the subsequent estimates based on standard maximum likelihood methods we have computed standard errors for the estimated coefficients but we cannot derive traditional goodness of fit indicators such as pseudo R-squared

In the set of estimates presented in table B1 we have included also observations weights. The weights are equal for each respondent to the inverse of the complete response rate of the related core-country (see table A1).

Table B1 Robustness controls. Models with imputed missing values and observations weights. Model I: probit model with dependent variable NETWORK; Model II: probit model with dependent variable INTERN; model III OLS model with dependent variable IF.

Models	I Large Network	II International collaboration	III IF of internationally co-authored papers
FOREIG BORN	0.2311***	0.429***	0.5462***
	(0.031)	(0.031)	(0.146)
RETURNED	0.1601***	0.250***	0.6591***
	(0.028)	(0.029)	(0.135)
SIZE		0.195***	0.3440***
		(0.008)	(0.035)
SIZE SQ		-0.005***	-0.0047***
		(0.000)	(0.001)
CORE_PROJ		0.060***	0.4316***
		(0.013)	(0.054)
AGE	0.0090***	0.003**	0.1007***
	(0.001)	(0.001)	(0.033)
AGE SQ			-0.0013***
			(0.000)
INDEPENDENT	0.3240***	0.013	0.6712***
	(0.032)	(0.032)	(0.166)
FEMALE	-0.1962***	-0.095***	-0.3349***
	(0.029)	(0.030)	(0.125)
Institution type dummy	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes
Field dummies	Yes	Yes	Yes
Constant	-1.6798***	-2.411***	-2.8004***
	(0.085)	(0.109)	(0.974)
Observations	15,813	15,123	3,707

PROGRAM TO PROMOTE INVESTMENT IN TECHNOLOGY-BASED AND INNOVATIVE COMPANIES: AN EXAMPLE OF A PROGRAM INSPIRED IN THE TRIPLE HELIX MODEL

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Abstracts
In a triple helix model, firms, government and universities are the most important actors. In the case referred in this paper, this actors are: the Administrative Department of Science, Technology and Innovation (Colciencias) which is the governmental body responsible for designing and implementing policies in science, technology and innovation in Colombia.; the Multilateral Investment Fund (FOMIN for its name in Spanish) which is an international organization affiliated to the Inter-American Development Bank (IDB); the National University of Colombia (UNAL) through its Corporate Entrepreneurship Unit and its Research Center for Development (CID for its name in Spanish); and the EAN University. The private sector is represented by the entrepreneurs and the new businesses that the program tries to support.
In May 2006, an agreement between IDB and Colciencias resulted in the "Program to Promote Investment in Technology-Based and Innovative Companies (FINBATEC for its name in Spanish)". The main purpose of the program was to support the development of the venture capital industry so that it could respond to the necessities of star-up companies. The three most important objectives of the program were (i) to count with 15 new technology-based companies three years after the conclusion of the program, (ii) to attract the attention of at least three national funds to invest in technological SME and (iii) the recognition of Colciencias as an important institution that promotes venture capital. In total, 50 technology-based entrepreneurship projects applied to the program and 30 of them were selected. Technical support offered by the UNAL allowed entrepreneurs to be trained in order to participate in an investment conference where they were expected to raise funds from participating investors. Nevertheless, none of the projects obtained private funds through this mechanism.
We propose in our contribution to analyze the operation of the program, identifying the possible explanations for the lack of private investments in the entrepreneurships projects and the design, policy and implementation issues that resulted in the unsuccessfulness of the program. We propose a twofold methodology. In one hand we will analyze the projects that participated in the program, we will identify the specific sectors in which their activities would be frame, the market opportunities and the technological state. On the other hand, we will analyze the structure of the program, the policy design and implementation, the requirements of the projects and the selection mechanisms applied, the agenda setting and priorities, the monitoring and control tools used and any other characterizing elements that facilitate the understanding of the program´s gaps and shortcomings allowing for policy learning.

Keywords: Entrepreneurship, Government, University, Technology, Business

Introduction

Triple helix models rely on the coordinated interaction between firms, government and universities. In the case referred in this paper, these actors are: the Administrative Department of Science,Technology and Innovation (Colciencias) which is the governmental body responsible for designing and implementing policies in science, technology and innovation in Colombia.; the Multilateral Investment Fund (FOMIN for its name in Spanish) which is an international organization affiliated to the Inter-American Development Bank (IDB); the National University of Colombia (UNAL) through its Corporate Entrepreneurship Unit and its Research Center for Development (CID for its name in Spanish); and the EAN University. The private sector is represented by the entrepreneurs and the new businesses that the program tried to support.

Preliminary findings suggest that one of the problems in the design of the program was the lack ofattention to the management of time required in entrepreneurship projects. We believe as well thatthe selection process could have been more assertive in identifying the project´s market viability,emphasis made on the business plan was at the expense of attention to the business model. As aconsequence of this, entrepreneurs were not sufficiently prepared to present their project to funding opportunities.

We would like to mention that in general, the efforts to commercialize technology and generate university spin-offs are still immature in Colombia. The role of universities in cooperation programs needs to attend to appropriate management structures for the intellectual property rights, policies and incentives to the academic staff could include promotion of application of research results in new businesses. We believe that it would be beneficial to establish business incubators or accelerators inside the universities, to foresight the potential applications of the results of their research projects and capacities. The evaluation of the appropriateness of the national institutional framework for opportunity entrepreneurships is something that needs to be done in Colombia.

This text is constituted by six parts. In the first part we will introduce some of the triple-helix model assumptions functions and advantages which we believe are fundamental to understand the program we will present and its difficulties. We will follow with the presentation of the methodology used, and in the third part we will describe the FINBATEC program, its purpose, its targets, its design and general policy in more detail. In the fourth part we will detail the characteristics of the entrepreneurs that participated in the program, the economic sectors to which they belonged, their market orientation and their technological conditions. We will follow with our explanation of the difficulties of the program and the elements that need to be taken into account in the design of similar programs. We will conclude in the sixth section of the document.

1. Triple helix models

Innovation as driver of social and economic development has implied since the XX century, prioritization of innovation models to guide public policy. These policies have in common the use of science and technology towards the improvement of the productive capacities of a region, relying on knowledge as fundamental element for the generation of competitive advantages.

In this context, the triple helix model, emphasizing on the relationships between academia, industry and government in the innovation system, takes universities as an strategic actor in the generation of knowledge and entrepreneurships with scientific capacity. The central role of these institutions is to contribute through scientific and technologic research to the differentiation of knowledge contributing competitive advantages to national firms in global markets.

The model relies in the existence of dynamic interactions among the three actors (academia, industry and government) where the institutions take on roles and functions from the others through which can generates new results in innovation knowledge-based (Gonzalez, 2009). This way, universities get new roles like the generation of new knowledge based entrepreneurships while the government must give the appropriate support through policies, norms, laws or capital investment.

Transition towards knowledge based economic development could be measured by the increased participation of universities and institutions alike to national or regional development (Etzkowitz, 2002). Three requirements must be followed in this transition towards knowledge-based economies:

1. A knowledge space where different actor can interact in their aim to find in R&D and similar projects innovative solutions for regional problems
2. A space for consensus where academic, public and private institutions interact and generate ideas and strategies.
3. Innovation space where additionally to the generation of innovative solutions, ideas and strategies, public and private venture capital converge. (Etzkowitz, 2002; Gonzalez, 2009)

A program under a triple helix structure has important advantages for the productive activity of of a region such as the generation of synergies, improved innovative capacities due to the support of learning processes by universities, and potential increases in the generation and application of knowledge to marketable innovations.

2. Methodology:

We propose in this contribution to analyze the operation of the program, identifying the possible explanations for the lack of private investments in the entrepreneurships projects and the design, policy and implementation issues that resulted in the unsuccessfulness of the program. We propose a twofold methodology. In one hand we will analyze the projects that participated in the program, we will identify the specific sectors in which their activities would be framed, their market opportunities and their technological state. On the other hand, we will analyze the structure of the program, the policy design and implementation, the requirements of the projects and the selection mechanisms applied, the agenda setting and priorities, the monitoring and control tools used and any other characterizing elements that facilitate the understanding of the program´s gaps and shortcomings allowing for policy learning.

From a triple helix perspective, the program FINBATEC and the participating institutions are summarized in the following figure: (insert)

3. About The Finbatec program

Five important events should be considered as historically relevant for the development of the FINBATEC program: (1) Colciencias, with the financial support from the IDB, developed from 1984 to 2002 programs specifically oriented towards funding R&D projects, doctoral formation, technological development centres and productivity centres, technology-based business incubators and alliances of firms and universities or firms and technological development centres. (2) In 1995 Colciencias and the institution promoting technical and technological formation (SENA), initiated a process of creation of technological based business incubators in the different regions of the country. To promote collaborations between public, private and academic sectors, and to create the capacity to absorb and apply research developed inside universities and research groups and

centres. (3) In 1997, the coordinating board for scientific and technological policy introduced entrepreneur capital funds as part of the National System of Innovation (4) The Colombian Venture Investment Fund (FCICR for its name ins Spanish) was created in 1998 to attract private investors to support technology based business incubators. And (5) IDB sponsored the creation of the FINBATEC as a response to the incipient entrepreneur capital activity in the country.

The program aimed at contributing to the development of capital for entrepreneurships in Colombia specifically for small and medium enterprises. The program had three important components (a) identification, structuration and application of support mechanisms for the incorporation of private capital. (b) socializing the characteristics of the available market of private capital for entrepreneurships and the experiences gained by the program. (c) Institutional strengthening ofColciencias in matters of entrepreneurships and entrepreneur capital. Initially, the program was designed for a duration of 36 months but it was extended for 24 additional months due to some delays and an intermediate evaluation. The program ended in November 2011. US$654.991 was the estimated cost of the program, 60% (US$392.994) was funded by the IDB and the remaining 40% (US$261.997) by Colciencias. The amount spent through the program was lower than estimated, being of only US$494.507, US$303.753 of the resources provided by the IDB and US$190.754 of those provided by Colciencias.

In the institutional arrangement participated Colciencias as the executing agency, an assessment board with the participation of a professional association (ACOPI), stock market representatives, Colciencias, IDB, an agricultural trust fund, ministry of commerce, and the Business Development and foreign trade Bank from Colombia (Bancoldex) and finally an executing agency in charge of the management of the program.

The main activities were: (i) provide technical assistance to the business plans for the selected entrepreneurships (ii) make a diagnosis of the institutions offering private capital for entrepreneur efforts (iii) analyze the entrepreneurs presented and their capital requirements (iv) design funding mechanisms considering the possibility of partial grants (v) apply the designed mechanisms, (vi) socialize the designed mechanisms in a broader group of entrepreneurships and institutions (vii) organize business meetings the search for private capital of new entrepreneurship projects (viii) support the mobilization of members of the executing agency to countries with a developed market of funds for new entrepreneurs. (ix) provide training in these issues.

Expected results: (i) sensibilization of 680 actors (ii) diagnosis of the funding opportunities for entrepreneurships (iii) diagnosis of the entrepreneurship projects (iv) new mechanisms (v) application of new mechanisms to 30 entrepreneurships of which 5 should also be able to obtain private funds (vi) training inside Colciencias of the sypply and demmand of funds for entrepreneurs and the design and execution of support mechanisms for the business sector.

Colciencias held a public hold to identify the potential entrepreneurship projects to participate in the program. 70 projects were initially received and 30 of them were selected. The entrepreneurs received technical assistance for the elaboration of their business plans through a special dependency of the National University of Colombia. Only 21 entrepreneurs designed the business plans. To the business meeting organized, fourteen of the entrepreneurs participates and five investment funds. A private university (EAN) was hired for diagnosis of the funding opportunities for entrepreneurships and the demand diagnosis by the Research Centre for Development which belongs to the National University of Colombia. Six workshops for the socialization of the results

were held in different parts of the country.

The program had many drawbacks. Worth mentioning is that inability to articulate private capital in five of the entrepreneurship projects which was the main purpose of the program. In section 5 we will emphasize on our explanations for the difficulties in achieving this objective.

4. Characteristics of the entrepreneurs participating in the program

Three of the 30 entrepreneurs participating in the program decided to cancel their participation and that explains why the technical assistance was only offered to 27 projects. The projects originated in the principal cities of Colombia: Bogotá (36.7%), Manizales (20%), Medellin (16.7%), Cali (13.3%), Bucaramanga (6.7%), Pereira (3.3%) and Ibague (3.3%). Of the presented projects, 44.4% corresponded to product entrepreneurships, 22.2% to services and the remaining projects included both product and service entrepreneurships. As a requisite, projects needed to be innovative and be subject to apply to intellectual property rights. 14.8% of the projects had at least one patent and 7.4% a pending patent. 29.6% used other protection methods and the remaining 48.1% were innovative but not subject to intellectual property protection as they responded to incremental innovations or innovations only to the national market or the firm. In total, eleven projects were applications to ICT industries, six to the food processing or agricultural industry, five to chemical and petrochemical industries, two to industries in electric and electronics, two to pharmaceutical and health industries and one to textiles and confection.

Entrepreneurships in Colombia have been more associated with need than market opportunities. This was reflected in the organization of personal behind the projects presented to the program. Entrepreneurships as a consequence of lack of other better opportunities were the case for eleven projects which were also presented by family groups. This could also be the case for four projects which were reported as means to increase the income and were the dedication to the project was of half time. The remaining twelve projects responded to an identified opportunity.

Another indicator that can be used to assess the maturity of the project is the amount of time being invested in it. Projects younger than one year have more uncertainty in their outcomes than longer projects. Nevertheless, it could also be expected that projects were more than four years have been invested lack a concrete market cliché, in light of the speed of technological change four years can be a time so long that an innovative idea becomes obsolete and other competitors might already be occupying the market arena. Of the approved projects, more than a third had between three and five years, another fourth part had more than ten years and the remaining projects had between six and ten years. In other words, only seven projects had business success potential. Forty percent of the projects belonged to operating firms, 30% were in the negotiation stage and had some advances in research and documentation, 15% had registered the firm in the chamber of commerce but was not operating and the remaining 15% were at the stage of an idea.

Entrepreneurships were using own resources in 44% of the cases, in the remaining, mechanisms as bank loans, prizes, public offerings, university support and others were used as a source of funding. Around 26% of the entrepreneurships demanded less than US$ 115.000 to execute the project, 19% required between US$ 115.000 and 230.000 and, 22% between US$230.000 and 576.000 and the remaining 33% more than US$ 576.000. The amount required was proportional to the technological development of the entrepreneurship, the degree of novelty, the type of product to develop the specialization of the equipment required and the need of specialized providers.

5. Findings

The program looked to integrate agents with heterogenous characteristics with complementary functions. It engaged universities and incubators to train and develop competencies in the final users of the program (the entrepreneurs). The IDB was also part of the project as well as Colciencias. It was an innovative program with complex objectives.

The five years that the program lasted presented a lot of difficulties and it evidenced the degree of isolation and between the agents which meant obstacles for the entrepreneurs. The lack of appropriate mechanisms to finance and stimulate entrepreneurships was also evidenced from the study of the supply and demand of mechanism to finance entrepreneurs.

From our analysis we can pinpoint to the main drawbacks of the program as:

- The schedule of activities lacked an appropriate planning due to a lack of knowledge and experience on this type of programs and activities. Most activities were not carried out in the specified times. This was associated to the lack of an entrepreneur culture in the country. Rules and compromises were not clear for the participating parts. The technical assistance offered by the university did not fulfill the expectations of the

projects and in general more resources for the training of the managers and executers of the program were required.
- The technical assistance offered did not considered the different characteristics and needs of the entrepreneurs and the characteristics of their projects. As no personalized assistance was offered, the projects could not use the universities' knowledge to work in their specific weaknesses.
- The diagnosis of the market of financial opportunities for entrepreneurs was shallow and did not considered all the needed aspects to be strengthened, there was a lack of emphasis in the demand, supply and ecosystem elements and the difficulties in meeting demand and supply were not attended.

Main drawbacks of participants:
- Most entrepreneurship lacked a monitoring system to track their activities, budgets were not assigned to specific activities. There was a lack of planning in general, time and financial, no market research or organizational structures defined.
- There was no research on the viability of the final product of the entrepreneurship, a validation of the product of service was lacking. Segmentation criteria or expected sizing of the market was lacking. In general, the selected entrepreneurships did not meet the technical requirements of the program.
- In time of the business meeting the entrepreneurs were not mature enough to be presented to potential private investors. Investors did not find the projects attractive as they could not demonstrate their businesses success potential.
- Support entities (incubators and universities) did not gave suficient attention to the market and the funding sources, they supported the business plan without concern to the special characteristics and requirements of each entrepreneur. Entrepreneurs were left with the sensation that this entities were unable to offer the required support.
- The assessment boar did not exercise its function properly; it did not support the program technically nor strategically. Meetings to evaluate the programs advances were not held. The function of monitoring of the program was not exercised.
- There was not a lot of experience in the programs of support to the private productive sector, specially to entrepreneurs. This was the first time that Colciencias participated in such a program and many problems were presented in the conceptualization and planning of the program. This was reinforced by a lack of human resources qualified and also by rotation of personal working in the program.

Conclusions

Although none of the projects presented to FINBATEC received private funding during the program, some projects have been able to articulate private funding after the program. For example, CLEARBEAM continued working with the National University and have been able to funding from one private investor for US$ 8 millons.

It is worth mentioning that the program served as a incentive for Colciencias to become more visible as a promoter for this type of incentives. Colciencias has been recognized as a promoter of science and technology but its role as a promoter of innovation is still low. Colciencias, together with other institutions has been working in strengthening the entrepreneurs ecosystem through workshops and meetings were different agents participate. Although the program was not successful, it allowed to pinpoint some of the difficulties that need to be addresses when designing and executing a similar program. Nowadays, three initiatives have taken the experience of FINBATEC to build their own proposal of programs:
1) A permanent program in Colciencias for technology-based entrepreneurships which has opened two calls to support (financially and conceptually) these type of projects. This program stands in the triple helix model, it requires the participation of incubators or universities to support the training to entrepreneurs 2) The program of the telecommunications ministry that, together with Colciencias, support ICT´s based entrepreneurships. This program is designing different services to contribute in the entrepreneur's ecosystem
3) The project of the ministry of finance that together with Bancoldex aims at strengthening the ecosystem to promote technology-based entrepreneurs. This project aims at creating a continuous flux of sustainable projects and resources.

References

Audretsch, D and A. Thurik, 2001. What is new about the new economy: sources of growth in
the managed and entrepreneurial economies. Industrial and Corporate Change. Vol. 10. No. 1. pp.

267-315.
Blume, S. and L. Loet, 1984. The Role of the University in Today's Economy, Special Issue of the Intern. Journal of Institutional Management in Higher Education. No. 8. pp. 97 181.
Colombo, M. and M. Wright, 2009. Dynamics of science-based entrepreneurship. Journal of Technology Transfer. No. 35. pp. 1-15.
Chang, H., 2010. El Modelo de la Triple Hélice como un medio para la vinculación entre la universidad y la empresa. Revista Nacional de Administración. Escuela de Ciencias de la Administración, Universidad Estatal a Distancia. Costa Rica.
Etzkowitz, H., 1994. Academic-Industry Relations: A Sociological Paradigm for Economic Development. in Leydesdorff, L. and V. Besselaar. 1994. pp. 139-51.

________, 1995. The Triple Helix of University-Industry-Government Relations: A Laboratory for Knowledge Based Economic Development. *EASST Review* 14. No. 1. pp. 11-19.
________, 1998. The Triple Helix as a Model for Innovation Studies. Science & Public Policy. Vol. 25. No. 3. pp. 195-203.
________, 2002. The Triple Helix of University - Industry –Government, Implications for Policy and Evaluation. Science Policy Institute. Working Paper. Available from: http://www.sister.nu/pdf/wp_11.pdf.
Farmer, M. and B. Ray, 1981. Entrepreneurship and government policy: the case of the housing market. Journal of Public Policy. Vol. 1. No. 3. pp. 307-332. Published by: Cambridge University Press.
Ferreira, N et al, 2010. SESI Social Entrepreneurship Program in the state of Paraná/ BR: Triple Helix in action. VIII Triple Helix Conference. Madrid, España.
Gonzales, T. 2009. Triple Helix Model of Relations Among University, Industry and Government: a Critical Analysis. ARBOR Ciencia, Pensamiento y Cultura. CLXXXV 738 pp. 739-755. Spain
Leydesdorff, L., 2001. Knowledge-Based Innovation Systems and the Model of a Triple Helix of University-Industry-Government Relations. Science and Technology Dynamics. University of Amsterdam. The Netherlands.
Leydesdorff, L., and Zawdie, G., 2010. The Triple Helix Perspective of Innovation Systems. Technology Analysis and Strategic Management.
Rodríguez, A., 2009. Nuevas perspectivas para entender el emprendimiento empresarial, Pensamiento y gestión. No. 26. pp. 94119.
Published by: Universidad del Norte. Colombia.
Shaker, Z., 1996. Governance, ownership, and corporate entrepreneurship: the moderating impact of industry technological opportunities. The Academy of Management Journal. Vol. 39. No. 6. pp. 1713-1735. Published by: Academy of Management.
Shane, S., 2004. Technological innovation, product development, and entrepreneurship in management science. Management Science. Vol. 50. No. 2. pp. 133-144. Published by: Institute for Operations Research and the Management Sciences INFORMS.
Terrence, B. and W. Johan, 2001. An operationalization of stevenson's conceptualization of entrepreneurship as opportunity-based firm behavior. Strategic Management Journal. Vol. 22. No. 10. pp. 953-968. Published by: John Wiley & Sons.
Valenciano, J. and T. Juan, 2009. Emprendimiento de la economía social y desarrollo local: la promoción de incubadoras de empresas de economía social en Andalucía. Revista de Economía Pública, Social y Cooperativa. No. 64. pp. 5-33. Centro Internacional de Investigación e Información de la Economía Pública, Social y Cooperativa CIRIEC. España.
Vélez, J., 2011. Impacto de las TIC en el emprendimiento empresarial: Estimaciones econométricas a nivel de un panel de países. Actas de la V Conferencia ACORN-REDECOM. Perú.

SOURCES OF INFORMATION AND ITS EFFECT ON NOVELTY OF INNOVATION: CASE OF MANUFACTURING AND SERVICE SECTORS IN NIGERIA

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Abstract
This paper explores the effect of internal and external sources of information on innovation. The study assessed the impact of four categories of sources of information that firms use to develop or improve their products and processes in both the manufacturing and service sectors. The following sources were examined:- internal sources, market sources (suppliers, clients/customers and competitors), institutional sources (universities and research institutes) and other available sources of information (conferences, trade fairs, scientific journals, and professional/industry associations). Three major questions addressed in the paper are: What is the extent of novelty of innovations in Nigerian manufacturing firms? What are the determinants of novelty of innovations? "Are there sectoral differences on the firms sourcing of information for innovation? The dependents and independents variables used in this study were derived from a nation-wide study which measured the state of innovation of Nigerian firms between 2005 and 2007. The dependent variable used is the degree of novelty of the innovation among firms. Questions were asked whether the goods and services developed were: a. new to your market? b. Only new to your firm? The independent variables used to explain innovativeness of firms are the following: internal sources of information; market sources of information; and institutional sources of information used in the innovation process. Also, some other variable to measure degree of novelty in the paper are use of collaboration, government support, size of firms and technological intensity of firm in the two sectors. The Nigerian Innovation Survey was also used to estimate two binary logistics models using innovativeness as its qualitative dependent variable. Novelty of innovations occurs at both the firm and market levels. For innovation to occur, the novelty must at least occur at the firm level. Tests of differences of innovativeness are made for sector and sources of information used to develop or improve products or processes in order to capture some of the variations occurring within the Nigerian innovation system. The survey methodology and instrument were based on a uniform African framework adapted by NEPAD under the African Science, Technology and Innovation Indicators (ASTII) Initiative. This framework was guided largely by the third edition of the "Proposed Guidelines for Collecting and Interpreting Technological Innovation Data", popularly referred to as Oslo Manual. The national innovation survey was conducted by NACETEM in line with its mandate of conducting policy research in STI management on behalf of the FMST.

Keywords: Sources of Information, Novelty of innovation, Nigeria, Manufacturing sector, Service sector

1. INTRODUCTION

Several authors have established the positive relationship between firm's innovativeness and performance (Soni etal, 1993, Kemp etal, 2003). The degree of novelty however differs from firm to firm. In the OECD's Oslo Manual, novelty of innovation is determined at three levels: new to the firm, market or world. For a firm to be innovative, it must at least have introduced an innovation at the firm level (OECD, 2005). Since all innovations contain a certain degree of novelty, measuring the degree of novelty helps us to identify whether an enterprise creates new knowledge or uses already existing knowledge. However, it was also Schumpeter who warned us that the process of innovation itself is indeterminate; for if you could determine the significance of something new at the start then innovation would no longer be a unique and highly valued accomplishment. He went on to state that it was the requirement of novelty that renders the process of innovation indeterminate, and so he considered explaining how novelty is moved from an indeterminate to a determinate state to be the greatest unmet scientific challenge (Carlile and Lakhani, 2011). Newness to firm can come in the form of technology adoption or minor or incremental changes. In technology adoption, firms can acquire innovative products and processes from sources external to the firm, with little or no further work required. Incremental changes involve modification to products and processes. This can be made to both purchased products and processes or to technologies developed by the firm itself in a previous time period. Important to the innovation process are variety and type of available source of information (Carlile and Lakhani, 2011).

In a study prepared for Industry Canada, based on the 1999 Statistics Canada Innovation Survey, the tendency of firms to develop innovations was evaluated based on their use of individual or network of information sources. The study found out that firms that depend on market sources such as suppliers, clients and competitors are likely to introduce firm-level innovation. However, firms that use information sources from R&D, government agencies and laboratories are more likely to develop innovations at the market or world level. Also, world level innovations are more likely to be developed by firms that utilise information from a variety of research or internal sources than those from a variety of market sources (Landry and Amara, 2003).

The incidence and type of innovation vary across industrial sector. Mahdi (2002) argues against the 'one best way' assumption in most innovation models. Instead, he posited that there are major differences in innovation processes across and within different industrial sectors. Miller and Blais (1993) show significant differences in innovation strategies among firms within six industrial sectors spanning manufacturing and services (pharmaceuticals, finance, software, metallic products, pulp and paper, and apparel and clothing). Though, innovation measurement in the manufacturing sector has been widely undertaken, attempt at measuring same in the services has been in the embryonic stage. The OECD Oslo manual has standardized the collection of data on innovation especially in the manufacturing sector. Since the first edition in 1989, several innovation studies have been undertaken with lessons for policy in developing and developed countries. Innovation types, obstacles, effects and government support for innovation have enriched policy and academic discourse. However, not much has been done on measuring innovation in the services sector despite its increasing important to economic growth. Between 1990 and 2002, the growth in world services trade was 155 percent while those for manufacturing and agriculture were 97 percent and 40 percent respectively (Kumar, 2005). In the emerging economies, the impact of the manufacturing sector is waning while service sector is becoming more prominent. In India for example, the industrial sector's share fell from 19.8% in 1990–01 to 18.5% in 2008–09. Meanwhile, the services sector's share increased substantially from 48.8% in 1990–01 to 64.5% in 2008–09 (Das etal, 2011). In 2008–09, almost 88% of India's GDP growth was explained by the growth of the services sector. The need to measure innovation in the services sector has thus become more important. This has attracted attention especially with the third edition of the Oslo Manual which extended the definition of innovation to include marketing and organisational methods. The first edition of the Manual restricted the definition of innovation to technological product and process (TPP).

1.1 Innovation and Sources of Information

It is widely believed that innovation is a driver of economic growth and vital to the evolving a knowledge economy (NACETEM, 2010). For firms to gain competitive advantage, they must continuously introduce new products to the market. However, the process of innovation by firms is proportional to the availability and sources of information available to such firms (Venkataraman, 1997). Since innovation is a risky investment with a high level of uncertainty (Leiponen and Helfat, 2010), firms' chances of success can be enhanced using a variety of sources described by Nelson as "parallel path strategy" (Nelson, 1961). Though there is a higher tendency for firms to narrow their search for information for innovation to sources within their domain (Helfat, 1994), however, expanding the search to a variety of sources in different locations can improve the success of innovations (Laursen and Salter, 2006). Also, the nature of the sources e.g. customers, suppliers or research institutes is likely to determine the innovation outcome. More importantly is the effect of globalisation which has increased the sources and accessibility of information needed for innovation (OECD, 2005).

Based on the foregoing, this paper assesses the impact of four categories of sources of information used by firms to develop or improve their products and processes in both the manufacturing and service sectors of the Nigerian economy. These sources are internal, market (suppliers, clients/customers and competitors), institutional (universities and research institutes) and other sources of information (conferences, trade fairs, scientific journals, and professional/industry associations). The survey methodology and instrument were based on a uniform African framework adapted by NEPAD under the African Science, Technology and Innovation Indicators (ASTII) Initiative and guided by the Oslo Manual.

Specifically the study will be guided by the following research questions:

- What are the sources of information used by firm to develop innovation?
- What is the extent of novelty of innovations in Nigerian manufacturing firms?
- What are the determinants of novelty of innovations?
- Are there sectoral differences in firms sourcing of information for innovation?
- Which sources of innovation positively affect the development of novelty innovation?

2. METHODOLOGY

A structured questionnaire was used to obtain information from eligible respondents in each enterprise between year 2009 and 2010. The data used is from the first comprehensive innovation survey in Nigeria‘s manufacturing and service sectors. Data was collected through a systematic survey of enterprises in the two sectors using the multistage sampling technique. Classification of main activities of the sector was based on the ISIC revision 3.1. Firms with activities falling between divisions 13 – 37 were classified as manufacturing firms while those whose activities fall between divisions 50 – 99 were classified as service firms. During the selection process, a census of all enterprises on the Stock Market trade list belonging to the manufacturing and service sectors was taken while a proportional probability sampling (PPS) approach with a threshold of a minimum of 10 employees was used to select firms from the NBS Business Directory. The enterprises were stratified by sector and employee size. In sectors with few firms, a higher proportion, in some cases a census of firms was selected. In sectors with a relatively large number of firms, PPS was used. The selection from the NBS Business Directory was then harmonised with that of the Stock Market trade list to obtain a total of 1500 firms comprising 500 service firms and 1000 manufacturing firms. The first part of the data collection exercise was dedicated to confirming the addresses of the firms and identifying a contact person. In most cases, the Chief Executive Officer (CEO)/Managing Director (MD) in each of the 1500 enterprises was chosen as the contact person. All the firms that either relocated or closed down were removed from the sample and replaced with closely matched firms in terms of sector of operation and location. The sample size of 1500 firms was thus maintained.

To improve the response rate, several follow-up measures were used which included contacting respondents prior to the conduct of the survey and sending a cover letter from the Minister of Science and Technology and the Statistician-General of the National Bureau of Statistics. Other actions taken included telephone calls, re-visits etc. Initially, 574 completed questionnaires were retrieved from the manufacturing sector and 228 from the service sector. After final data cleaning, a total number of 521 cases were retained from the manufacturing sector and 207 from the service sector. In total, this represents a response rate of 48.5%.

The final results were extrapolated to the target population based on the weighted cleaned sample, representing both the manufacturing and the service sectors. In both sectors a total of 728 valid questionnaires were obtained, yielding an overall response rate of 48.5%. Due to the nature of the survey which is basically targeted towards the policy makers and general public, exploratory descriptive data analysis was mostly used. The following sources were examined:- internal sources, market sources (suppliers, clients/customers and competitors), institutional sources (universities and research institutes) and other available sources of information (conferences, trade fairs, scientific journals, and professional/industry associations). Three major questions addressed in the paper are: What is the extent of novelty of innovations in Nigerian manufacturing firms? What are the determinants of novelty of innovations? “Are there sectoral differences on the firms sourcing of information for innovation? The dependents and independents variables used in this study were derived from a nation-wide study which measured the state of innovation of Nigerian firms between 2005 and 2007. The dependent variable used is the degree of novelty of the innovation among firms. Questions were asked whether the goods and services developed were: a. new to your market? b. Only new to your firm? The independent variables used to explain innovativeness of firms are the following: internal sources of information; market sources of information; and institutional sources of information used in the innovation process. Also, some other variable to measure degree of novelty in the paper are use of collaboration, government support, size of firms and technological intensity of firm in the two sectors. The Nigerian Innovation Survey was also used to estimate two binary logistics models using innovativeness as its qualitative dependent variable. Novelty of innovations occurs at both the firm and market levels. For innovation to occur, the novelty must at least occur at the firm level. Tests of differences of innovativeness are made for sector and sources of information used to develop or improve products or processes in order to capture some of the variations occurring within the Nigerian innovation system.

3. FINDINGS AND INTERPRETATION

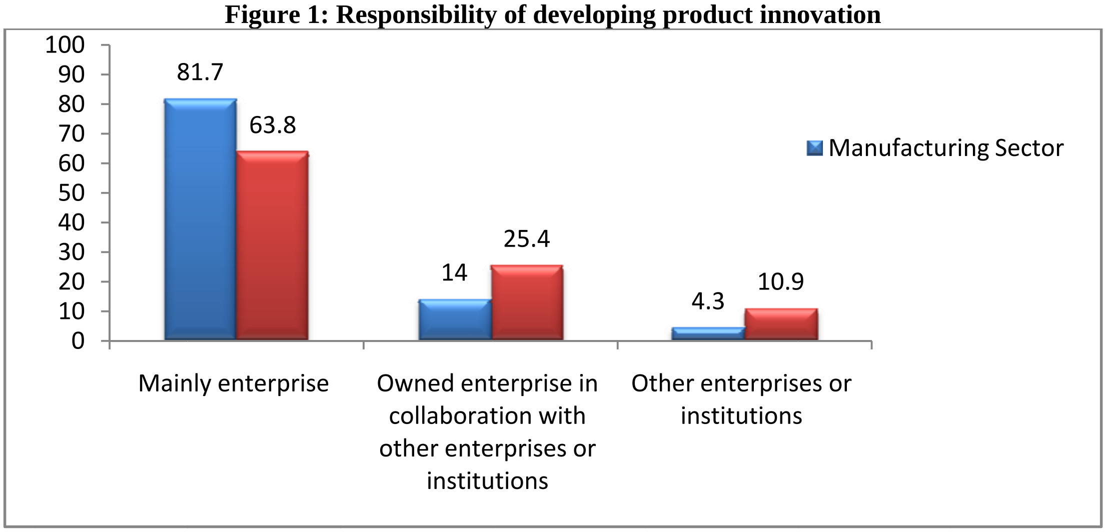
In this study, the findings we be presented in two parts. Part one will present the univariate analysis regarding various aspects of innovation and sources of information used to develop or improve products and processes. The second section, presents the results of the bivariate analysis and it makes use of chi-square analysis to explain the relationship between the dependent and independents variable. The third section presents the results of the multivariate analysis using binary logistic regression.

3.1. Innovation and Sources of Information Used by Firm To Develop Innovation

A total of 57.7% of innovative enterprises reported ongoing innovation activities during the period. The results show a higher rate of innovation within the service sector than manufacturing (Table 1). This is not surprising as the sector has become dynamic whose importance has continued to rise in most economies including Nigeria. It is projected to contribute about 35% of Nigeria's GDP in 2011 (NBS, 2010) from 27% in 1998 (Oyejide and Bankole, 2001).

The survey reveals that product innovations developed by Nigerian firms were mainly developed within the enterprise about 76%. Sectoral disaggregation shows a similar trend. About 82% of product innovations was developed 'mainly' by enterprises within the manufacturing sector while about 64% by firms in the service sector. Also, a higher proportion of product innovations was developed solely within the manufacturing than service sectors with about 80% and 69% respectively (Table 2). Less than 20% of the enterprises collaborated with other enterprises or institutions to develop product innovations(Table 2), while less than 11% relied on other enterprises or institutions to develop their innovations. This may imply that most enterprises in Nigeria are capable of developing their own products using available technologies instead of depending on foreign ones. The fact that these products are developed mainly within the enterprises pointed to the fact that the firms have internalised their innovation efforts.

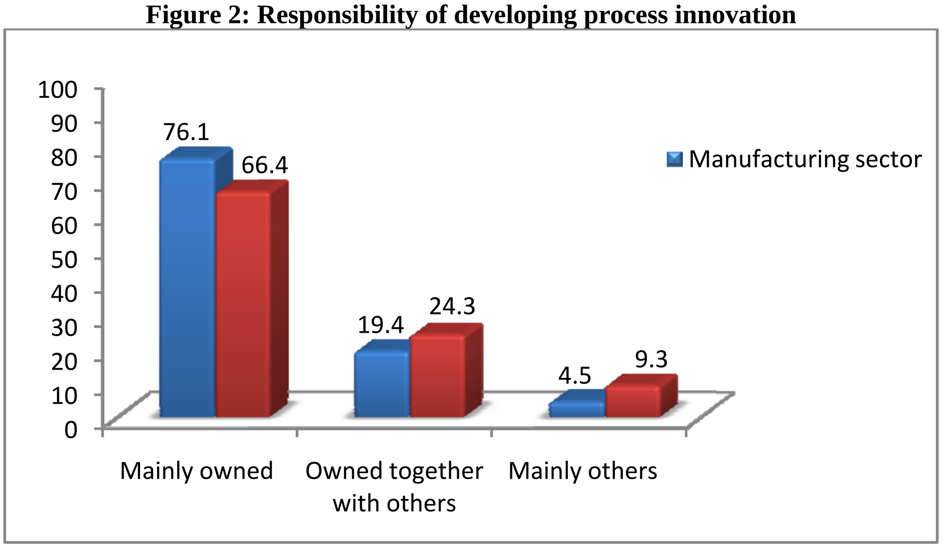
Figure 1: Responsibility of developing product innovation



About half of all innovative enterprises (54.9%) introduced process innovations involving new or significantly improved methods of manufacturing or producing goods and services. Some 50% of enterprises in both sectors developed new or significantly improved logistics, delivery or distribution methods for inputs, goods and services. In the third category of process innovation, about 50% of the enterprises produced new or significantly improved supporting activities for processes such as maintenance systems or operations for purchasing, accounting, or computing. In total, 54.1% of all enterprises developed process innovations (see Appendix Table A3). Enterprises in the service sector were more active in process innovations (67.6%) than enterprises in the manufacturing sector (63.3%).

Process innovations were mostly developed in-house; 73% of enterprises reported that innovations were developed mainly by their enterprises (Figure 4.6) with most of the process innovations (80%) originated mainly in Nigeria (Figure 4.7). Recent consensus among advanced industrialized economies is that innovation rarely occurs in isolation; it is a highly interactive and multidisciplinary process that increasingly involves collaboration by a growing and diverse network of stakeholders, institutions and users.(OECD, 2010). Some 21% of enterprises developed process innovations in collaborations with other enterprises or institutions while 6% of enterprises relied on other enterprises or institutions to develop process innovations for them. Over three-quarters of firms in the manufacturing sector developed process innovation solely within the enterprise compared to two-third in the service sector while about four-fifth and more than three-quarters of firms had the innovations originated within the country (Table 4.5). This shows that most enterprises in Nigeria are capable of developing their own processes instead of depending on foreign ones. The fact that these processes are developed mainly within the enterprises pointed to the fact that most firms used codified knowledge from acquisition of equipment and knowledge or open information sources rather than active co-operation with other institutions/firms to develop these new processes (Table 4.11).

Figure 2: Responsibility of developing process innovation



Though the propensity for product innovation is high in Nigeria, however, most of the innovations were new at the firm level. Only 29.7% of product innovation in service sector firms and 34.9% in manufacturing were developed at the market level (NACETEM, 2010; OECD, 2005). The mean share (38.1%) of innovative manufacturing enterprises whose innovations were new to the market was substantially higher than the corresponding share (30.1%) of innovative service enterprises. The mean share (36.2%) of service enterprises whose innovations were new only to the firm was higher than for innovative industrial enterprises (31.9%). However, the mean share of both sectors for goods and services that were unchanged or only marginally modified was about 45% (Table 1). This goes to confirm the fact that innovation landscape in Nigeria is characterized mainly by incremental innovation (NACETEM, 2010; OECD, 2005).

Table 1: Percentage of Total Turnover, 2007

Goods and service innovations during the three years 2005-2007	**Manufacturing**	**Service**
	Mean	**Mean**
Percentage of goods and service innovations introduced during 2005-2007 that were new to market	38.1	30.1
Percentage of goods and service innovations introduced during 2005-2007 that were only new to firm	31.9	36.2
Percentage of goods and service that were unchanged or only marginally modified during 2005-2007	44.5	45.8

According to OECD 2005, linkages in the innovation process are of three types: open information source, acquisition of technology and knowledge and innovation co-operation. Innovation co-operation involves active participation in joint innovation projects with other organisations. It allows enterprises to access knowledge and technology that they otherwise would be unable to utilise on their own. It also provides great potential for synergies as partners learn from each other. Co-operation partners could come from internal sources, external sources like competitors, customers, suppliers, or public sector institutions such as universities, research institutes etc. (OECD, 2005). From the descriptive analysis, it was found that most of the innovative firms partnered actively with clients or customers, other enterprises within the enterprise group and suppliers for innovation. However, consultants, commercial laboratories and competitors were found to be least valuable partner for innovation. Information on innovation collaboration among firms is shown in Table 2. It reveals that majority of the innovative firms (85.4% for manufacturing and 73.7% for service firms) did not cooperate actively with other firms/institutions for innovative activities. Although co-operation is a measure of linkage, this did not however depict a weak linkage. It only shows that most firms depended on other forms of collaboration; open-source or information from acquisition of technology or knowledge for innovation. This assertion is also supported by the fact that most innovations were developed mainly by the enterprise (see Fig.1 and Fig. 2)

Table 2: Innovation Co-operation among Firms

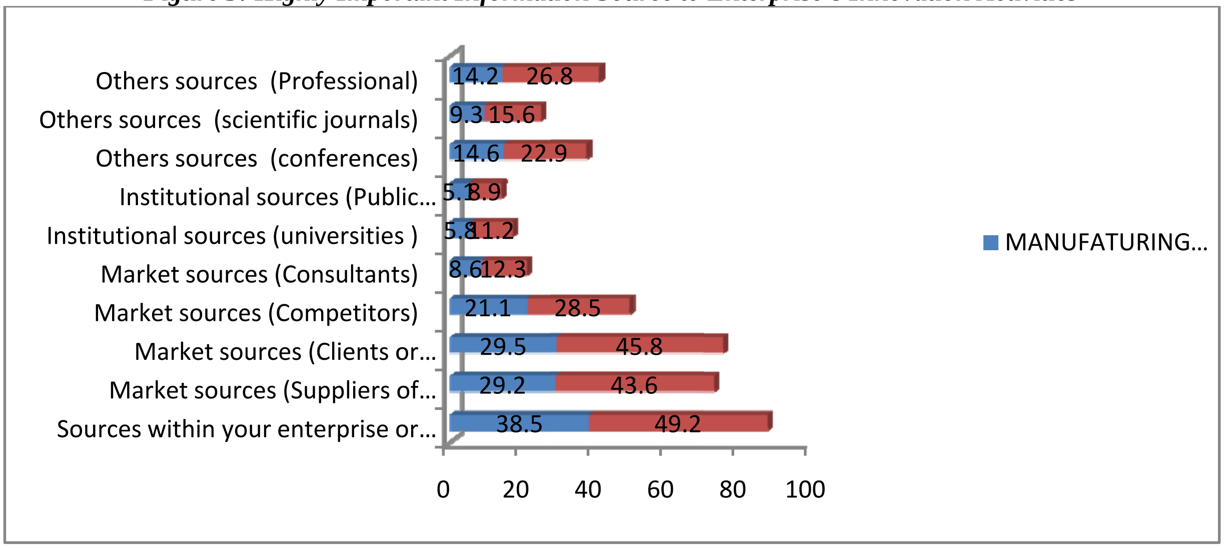
Innovation Cooperation	**Total**	**Manufacturing**	**Service**
Firms with Collaboration on Innovation	18.0	14.6	26.3
Type of Cooperative Partner			
Other enterprises within your enterprise group	16.4	9.5	25.5
Suppliers of equipment, materials, components or software	13.6	15.9	10.6
Clients or customers	10.0	9.5	10.6
Competitors or other enterprises in your sector	0.9	-	2.1
Consultants, commercial labs, or private R&D Institutes	5.5	9.5	-
No response	53.6	55.6	51.1

3.2. Extent of Novelty of Innovations

Studies have shown that to stimulate innovation, firms may get information from customers, suppliers, universities, research institutions, government/public authorities, consultants, press, trade fairs, conferences etc.

(OECD, 2010, 2008a, 2008b: Santamaria et al., 2009). For this study the categories used to measure the sources of information for innovation was adopted from those proposed in the Oslo manual (OECD, 2005a, 1997).

Figure 3: Highly Important Information Source to Enterprise's Innovation Activities



In the descriptive statistics a likert scale of 1- 4 was used to determine the

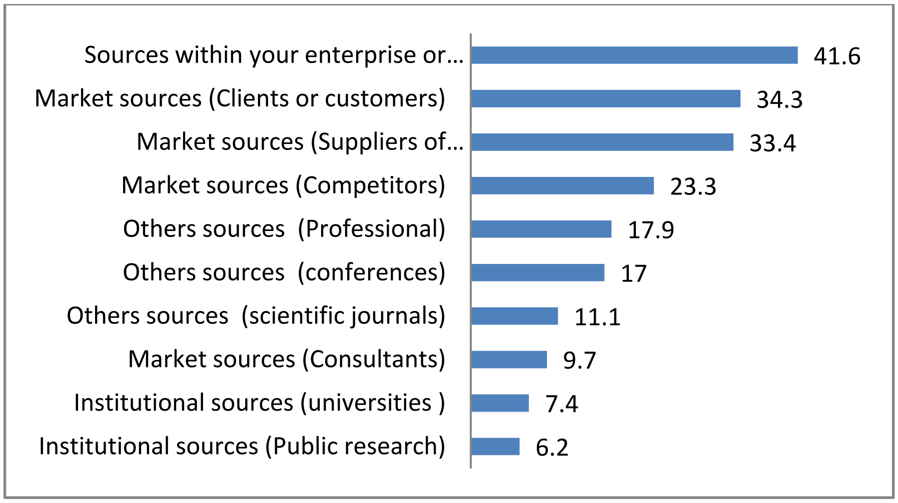
The following Table----- show the importance attached by manufacturing and service firms to sources of information for their innovation, degree of novelty, linked to the introduction of innovation. Firms were asked to attach to each specific factor a score equal to 1 _in case the factor was deemed to be not used at all. or, if perceived as low, a score between 1 to 4 according to its degree of importance _i.e. from 1: low, to 4: high. Tables -- show the percentages of firms which have indicated the factors listed in the table as 'highly important' _i.e. scores 4. The last columns of the tables show the ranking of the same factors _where applicable for manufacturing firms in the period 2005-2007. This allows to make a comparison of the importance of different information sources to innovation in services and manufacturing.

Table---- shows that sources within enterprise or enterprise group are the most important information sources in both manufacturing and service sector: 38.5% and 49.2% of innovating firms has indicated such information source as highly important or crucial. Studies of innovation have longed recognized the importance of external sources of information as determinants of innovation especially in the manufacturing sector(Lundvall, 1992). Looking at the importance of the same factors in manufacturing, it emerges that internal sources are confirmed to be very important in both service and manufacturing. The same holds true for clients or customers and suppliers of equipment, competitors.

The other external sources, i.e. consultants, higher institutions, conferences and others, play a less important role. Among the external sources clients and customers and suppliers of equipment, materials and components, are mentioned as 'very important' information sources by more than 40% of the firms in the manufacturing sector and almost 30% in service sector and . Universities, Research institutes (both public and private ones) and scientific journals and professional are perceived as 'very important' sources of information by a minority of service firms.

Also in manufacturing, private and public research institute, universities, scientific journals play a role as providers of technological information for very few firms. On the whole these data suggest that both in service and manufacturing technological information are generated internally through 'learning by doing' processes in the production departments and externally through both up-stream and down-stream user–producer interactions. It is also interesting to note that clients and customers rank very high both in manufacturing and in services, suggesting that a close user–producer interaction in innovation is not a peculiar feature of services but applies also to manufacturing.

Figure 4: Information Source Rated 'High' by Innovative Enterprises (Percentage)



Majority of innovative firms (41.6%) rated sources of information within the enterprise or enterprise group as the most important source of information for innovation (Figure 4.10). This was followed by 'clients or customers' (34.3%) and 'suppliers of equipment' (33.4%). However, most innovative firms found universities (7.4%) and public research institutes (6.2%) the least source of innovation information. This follows a similar trend in Ghana (CSIR STEPRI, 2010) and South Africa (HSRC, 2009). This calls to question the role of universities and public research institutes in the innovation process especially in developing countries.

For firms to innovate, information is crucial. This information can either be from open source, acquisition of technology and knowledge and from co-operation (OECD, 2005). The study reveals that about 18% of firms did co-operate actively with other organizations, knowledge institutions etc. for the innovation process (Figure). This depicts a weak linkage in the innovation system. Internal and market sources provided the most important information used in the innovation process while firms did not value information from universities and research institutes during the innovation process.

The survey found a weak linkage between the academia and the firms. It was observed that there were more linkages/partnerships with clients and customers. Studies in Ghana (CSIR STEPRI, 2010) and South Africa (HSRC, 2009) reveal similar results. This trend explained why most of the sources of information for innovation were got from sources within the firm or enterprise group and the market. The linkage between Nigerian firms and the academia is very low. Firms found information from clients, suppliers and sources within the firms more valuable that from the academia. This calls into question the role of the academia in the innovation process in Nigeria. However, bridging institutions like the Intellectual Property and Technology Transfer Office (IPTTO) should be strengthened to provide the link between the academia and the business sector. Radical innovations should be increased in developing policies that will promote stronger linkages between firms and the academia. These results suggest that in order to foster novelty of innovation in manufacturing and service firms, policy makers should continue to provide incentives regarding R&D, collaborative arrangements, and more generally, to provide a large variety of government support programs.

Table 3: Highly Important Information Source to Enterprise's Innovation Activities

Number of Innovative Enterprises		**Total**	**Manufacturing**	**Service**
Internal sources	Sources within your enterprise or enterprise group	254	166	88
External sources	Market sources (Suppliers of equipment)	204	126	78
	Market sources (Clients or customers)	209	127	82
	Market sources (Competitors)	142	91	51
	Market sources (Consultants)	59	37	22
	Institutional sources (universities)	45	25	20
	Institutional sources (Public research)	38	22	16
	Others sources (conferences)	104	63	41
	Others sources (scientific journals)	68	40	28
	Others sources (Professional)	109	61	48
Percentage of Innovative Enterprises				
Internal sources	Sources within your enterprise or enterprise group	41.6	38.5	49.2
External sources	Market sources (Suppliers of equipment)	33.4	29.2	43.6
	Market sources (Clients or customers)	34.3	29.5	45.8
	Market sources (Competitors)	23.3	21.1	28.5
	Market sources (Consultants)	9.67	8.6	12.3
	Institutional sources (universities)	7.38	5.8	11.2
	Institutional sources (Public research)	6.23	5.1	8.9
	Others sources (conferences)	17	14.6	22.9
	Others sources (scientific journals)	11.1	9.3	15.6
	Others sources (Professional)	17.9	14.2	26.8

H_0: Sources of information does not have significant effect on degree of novelty (no relationship/association)

H_i:Sources of information has significant effect on degree of novelty (there is r/ship)

Importance of Sources of information	B	Wald	Sig.	Exp(B)	95% C.I.for EXP(B)	
					Lower	Upper
Internal sources		4.919	.085			
Low	.057	.004	.947	1.059	.192	5.830
High	.913	4.381	.036	2.492	1.060	5.859
External sources(Suppliers of equipment, materials)		.159	.924			
Low	-.201	.082	.775	.818	.206	3.244
High	-.214	.155	.694	.808	.279	2.338
External sources(Clients or customers)		1.725	.422			
Low	.824	1.253	.263	2.279	.539	9.639
High	.002	.000	.997	1.002	.397	2.528
External sources (Competitors or other enterprises)		7.366	.025			
Low	.354	.414	.520	1.425	.485	4.189
High	1.167	6.693	.010	3.214	1.327	7.783
newq6.4dii		3.783	.151			
newq6.4dii(1)	.667	1.438	.230	1.948	.655	5.792
newq6.4dii(2)	-.380	.662	.416	.684	.274	1.708
Constant	-.017	.003	.956	.983		

Log(p/1-p) = B0 + B1X1+B2X2+....+BnXn

Log(p/1-p) = -.017 + .057* newq6.4a(1) + .913* newq6.4a(2)

OR = $e^{.057}$ =1.059

Sector of business activities	Degrees of novelty of innovation			
	New to market		New to firm	
	Number	% within New to market	Number	% within New to firm
Manufacture of food products and beverages	35	18.2	40	17.5
Manufacture of textiles	10	5.2	10	4.4
Manufacture of wearing apparel; dressing and dyeing of fur	5	2.6	4	1.8
Tanning and dressing of leather; manufacture of luggage, handbags,	8	4.2	9	3.9
Manufacture of products of wood, cork, straw and plaiting materials	6	3.1	11	4.8
Manufacture of paper and paper products	2	1	4	1.8
Publishing, printing and reproduction of recoded media	11	5.7	14	6.1
Manufacture of chemicals and chemical products	27	14.1	36	15.6
Manufacture of rubber and plastics products	8	4.2	7	3.1
Manufacture of other non-metallic mineral products	14	7.3	18	7.9
Manufacture of basic metals	9	4.7	10	4.4
Manufacture of fabricated metal products	15	7.8	18	7.9
Manufacture of machinery and equipment	3	1.6	4	1.8
Manufacture of office, accounting and computing machinery	1	0.5	1	0.4
Manufacture of electrical machinery and apparatus	3	1.6	3	1.3
Manufacture of other transport equipment	1	0.5	1	0.4
Manufacture of furniture	33	17.2	38	16.5
Recycling	1	0.5	1	0.4

Table – shows that

IMPORTANCE OF INFORMATION SOURCE	Degree of innovation						
	New to market				New to the firm		
	n	% within new to market	X^2		n	% within new to the firm	Pearson Chi-Square
Internal sources	194	74.3	18.371	0.001**	136	61.5	0.146
Suppliers of equipment, materials etc	194			0.032*	136		0.878
Clients or customers				0.019*			0.447
Competitors or other enterprises				0.333			0.499
Consultants , commercial laboratory				0.870			0.769
Institutional sources							
Universities or other higher institutions				0.500			0.854
Public research institutes				0.632			0.503
Other Sources							
Conferences , trade fairs, exhibitions				0.000**			0.392
Scientific Journals				0.021*			0.008*
Professional and Industry Associations				0.217			0.100
****. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).**							

Before carrying out the binary regression analysis, we examined a chi-square for the composite scales of the major constructs (see Table 2). The signs of the bivariate analysis appeared to be consistent with the proposition that a number of sources of innovation are positively statistically significant correlated with sources of information for innovation as well as with.

The concept of sources of innovation used in this study can be conveniently defined as the supply of knowledge that an organization utilizes to enhance innovation and achieve success in the marketplace. To stimulate innovation, firms may get information from internal sources (i.e sources within their enterprise or enterprise group), market sources (customers, suppliers, competitors and consultants); institutional sources (universities, research institutions, government/public authorities); and other sources like conferences, scientific journals technical report publications, press, trade fairs, professional and industry associations etc. (e.g. OECD, 2010, 2008a, 2008b: Santamaria et al., 2009). The result reported in Table- show that by comparison of firms introducing innovations that are firsts for them, firms developing innovations that are new to the market are more likely to use sources within their enterprise or enterprise group, suppliers of equipment, materials, components or software and clients or customers. They are most likely they use conferences, trade fairs, exhibition and scientific journals, trade /technical publications.

The result further shows that

Correlation coefficient analysis between degree of novelty and sources of information for innovation

The result showed no statistical significant between the

Binary Logistic regression

	Sig.	Exp(B)	Confidence Interval
Background characteristics	**Odds ratio**	**P value**	**Confidence Interval**
newq6.4a	.071	1.419	0.970-2.077
newq6.4b	.749	.930	0.594-1.455
newq6.4bii	.743	1.070	0.714-1.604
newq6.4di	.008	1.632	1.140-2.338
Constant	.099	.449	

External sources of innovation from suppliers provide interaction and synergies to design innovative products (Mcdermott and Handfield, 2000) In this respect, von Hippel (1988) has been a prominent advocate for the argument that customers, suppliers and internal departments are closely linked as major sources of innovative ideas for stimulating new products. Combining different product information from external sources increases the opportunities to create new product ideas (Baldwin and Hanel, 2003; Hutcheson et al., 1996). Research organizations (e.g. universities, research institutes, or consultancy) not only provide 9 new scientific and technological knowledge, but also collaborate with the firm and undertake applied research sponsored by them (Nieto and Santamaria, 2007). Some business consultancy provides information on technologies, product opportunities, sales and market trends, regulations and law, and financing, which improves firm performance (Feldman and Florida, 1994). These theoretical and empirical studies support the proposition that a variety of internal and external sources of knowledge for innovation are crucial for enhancing technological innovation capabilities in a firm, and that the improvement of such innovative capabilities also directly affect firm performance.
Our findings indicate that despite the important role of R&D in satisfying the needs for economic development, development of local technologies and adaptation to imported foreign technologies.

4. Conclusion

Innovations are key for a society's performance and progress. The information about and communication of new ideas, technologies, products, and services play a crucial role. For the diffusion of innovations it is essential to make them popular both among the specialist community and within broader parts of society. In this study the impact of sources of information used by firms to develop or improve their most important innovation was estimated at the level of the individual sources and at the network level.

The survey found a weak linkage between the academia and the firms. Rather it was observed that there were more linkages/partnerships with clients and customers. This trend explained why most of the sources of information for innovation were got from within the firm or enterprise group. Satisfaction of customer demands and improvement in product quality were found out to be the main reasons for innovation among firms in Nigeria while dealing with new competitors in export markets was the least important factor. The linkage between Nigerian firms and the academia is very low. Firms found information from clients, suppliers and sources within the firms more valuable that from the academia. This is also shown by the average incidence of R&D among firms. This calls into question the role of the academia in the innovation process in Nigeria. However, bridging institutions like the Intellectual Property and Technology Transfer Office (IPTTO) should be strengthened to provide the link between the academia and the business sector.

5. Policy Implications and direction for further research

In the course of writing this paper some important limitations were met which should be considered in interpreting the results of this study. The first limitation was that the novelty of innovation information used in this study was based on product innovation only. Secondly, variable on firm age despite its recognized importance in directly or indirectly affecting novelty of innovation in some past study, this variable is not included in the survey that provided the data for this paper and thirdly, only two of the three concepts for novelty of innovations discussed in the manual: new to the firm, new to the market, and new to the world were used in the paper. The reason for this is that these variable was omitted in the survey questionnaire that was used for analysis, in subsequent data collection it is expected that more data will be available to overcome challenges of these nature. Further research should be geared towards finding the source of innovation for those firms that reported not using any of the sources of information for innovation.

References:

CSIR STEPRI (2010). "The Ghana Innovation Survey Report 2009." Council for Scientific and Indutrial Research, Science Technology and Policy Research Institute

Gault, Fred (2008) Science, Technology and Innovation Indicators: Opportunities for Africa, *African Statistical Journal*, 6 (May), 141– 162.

Gault, Fred (2010) Innovation Strategies for a Global Economy: Development, Implementation *Measurement* and Management

HSRC (2009) Main Results of the South African Innovation Survey 2005. Human Science Research Council

OECD (2005), Proposed Guidelines for Collecting and Interpreting Technological Innovation Data: Oslo Manual, 3rd ed. OECD. Paris.

NACETEM (2010) Assessment of Innovation Capability in the Manufacturing Sector in Nigeria. Monograph Series, No 4: NACETEM

Rogers, Everett M.: Diffusion of Innovations, 5th ed., New York: The Free Press 2003; Weisenfeld, Ursula: Risk, Information and the Diffusion of Innovations. In: Albers, Sönke (Ed.): Cross-functional Innovation Management. Wiesbaden: Gabler 2004, pp. 277-294.

OECD (2005a). Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data 3rd Edition. OECD: Paris.

OECD (2008a). OECD Reviews of Innovation Policy China. OECD, Paris.

OECD (2008b). Open Innovation in Global Networks. OECD, Paris.

OECD (2010). The OECD Innovation Strategy: Getting a Head Start on Tomorrow. OECD, Paris.

Oyejide A.T., and Bankole A.S., (2001) Liberalisation of the Services Sector in Nigeria: Implications of Unilateral and Multilateral Approaches. Paper Prepared for the African Economic Research Consortium on Services Sector Liberalization in Nigeria (http://siteresources.worldbank.org/INTRANETTRADE/Resources/ServicesNigeria.pdf), World Bank, July 2011.

Santamaria, L., Nieto, M.J., Barge-Gil, A. (2009). Beyond formal R&D: taking advantage of other sources of innovation in low- and medium-technology industries, Research Policy 38: 507-517.

Urem, B., L. Alcorta and T, An, (2008). Foreign Ownership and Novelty of Product Innovation in China. Paper Presented at the XX Annual Globelics Meeting, Mexico.

Mahdi S. (2002), Search Strategy in Product Innovation Process: Theory and Evidence from the Evolution of Agrochemical Lead Discovery Process, DPhil Thesis, Unpublished, SPRU, University of Sussex, UK, 2002.

Venkataraman, S. (1997). The Distinctive Domain of Entrepreneurship Research. In J. Katz and R. Brokhaus, Eds. Advances in Entreprenuership, Firm Emergence and Growth. San Francisco, JAI Press

OECD (2005), Proposed Guidelines for Collecting and Interpreting Technological Innovation Data: Oslo Manual, 3rd ed. OECD. Paris.

Carlile P.R and Lakhani K.R. (2011). Innovation and the Challenge of Novelty: The Novelty-Confirmation-Transformation Cycle in Software and Science. Harvard Business School Working Paper 11-096

Landry, R. and N. Amara, (2003). Effects of Sources of Information on Novelty of Innovation in Canadian Manufacturing Firms. In *Understanding Innovation in Canadian Industry*, F. Gault, ed. Montreal: McGill-Queens University Press.

Das A, Banga R and Kumar D (2011). Global Economic Crisis: Impact and Restructuring of the Services Sector in India. ADBI Working Paper Series, No. 311

NACETEM (2010) Assessment of Innovation Capability in the Manufacturing Sector in Nigeria. Monograph Series, No 4: NACETEM

Leiponen A and Helfat C.E. (2010). Innovation Objectives, Knowledge Sources, and the Benefits of Breadth. Strategic Management Journal, 31: 224–236

Nelson R. (1961). Uncertainty, Learning, and the Economics of Parallel Research and Development Efforts. *Review of Economics and Statistics* **43**(4):351–364

Helfat C.E. (1994). Evolutionary Trajectories in Petroleum Firm Research-And-Development. *Management Science* 40(12): 1720–1747.

Laursen K. And Salter A. (2006). Open for Innovation: The Role of Openness in Explaining Innovation Performance among U.K. Manufacturing Firms. Strategic Management Journal, 27: 131–150

Kumar, P. (2005), “Services Negotiations in Doha Round: Concerns of South Asia.” CUTS, Jaipur

Soni, K.P., Lilien G.L., and Wilson D.T. (1993) Industrial Innovation and Firm Performance:

A Re-conceptualization and Exploratory Structural Equation Analysis. International Journal of Research in Marketing 10 (1993) *365.380*

Kemp R.G.M, Folkeringa, M., de Jong, J.P.J., and Wubben, E.F.M. (2003) Innovation and firm performance, Research Report H200207 of SCientific AnaLysis of Entrepreneurship and SMEs (SCALES)

APPENDIX

Types of Innovation

6. Product Innovation

Table 4.4: Product Innovation in Nigerian Firms (Percentage)

	Manufacturing	**Service**
Product Innovation		
Enterprise introduced new/significantly improved goods	48.6	38.6
Enterprise introduced new/significantly improved services	40.7	62.3
Responsibility for Development of Product Innovation		
Mainly enterprise	81.7	63.8
Owned enterprise in collaboration with other enterprises or institutions	14.0	25.4
Other enterprises or institutions	4.3	10.9
Origin of Innovation		
Nigeria	80.2	68.8
Abroad	19.8	31.2
Degree of Novelty of Innovation		
New to market	34.9	29.7
Only new to firm	65.1	68.1

Process Innovation

Table 4.5: Process Innovation in Nigerian Firms (Percentage)

	Manufacturing	**Service**
Process Innovation		
Enterprise introduced new or significantly improved methods of producing goods	54.9	42.0
Enterprise introduced new or significantly improved logistics, delivery or distribution	47.8	51.2
Enterprise introduced new or significantly improved supporting activities for your processes	49.1	56.5
Responsibility for Development of Process innovation		
Mainly owned	76.1	66.4
Owned together with others	19.4	24.3
Mainly others	4.5	9.3
Origin of Innovation		
Nigeria	81.5	77.1
Abroad	**18.5**	**22.9**

HETEROGENEITY IN FIRMS' INNOVATION ACTIVITIES: SIZE, OWNERSHIP AND SECTOR DO MATTER

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Abstract
The proposed paper seeks to provide a better understanding of firm behaviour by analysing qualitative features of innovation processes like motivations, dynamics and collaboration among actors. Based on these findings, it is also aimed at improving STI policies. It is based on interviews conducted at around 60 innovative firms in 3 sectors (automotive, pharmaceuticals, and information and communication technologies), as well as on a statistical and institutional analysis of the national innovation systems (NIS) in six countries (Austria, Bulgaria, Hungary, Poland, Slovenia, the UK). The sectors have been selected given their significant economic relevance in terms of employment, contribution to GDP and exports, as well as taking into account the major features of the respective NIS.
The results confirm that size, ownership as well as sector cause fundamental differences in innovation strategies and activities of firms. In general, small, domestic firms in less developed economies lack the necessary skills and resources to devise explicit innovation strategies, and hence usually deal with business and technological uncertainties in an ad hoc manner. Subsidiaries of foreign firms, which tend to be large, organise their RTDI activities in accordance with the overall business and innovation strategies of their parent firm. The paper offers a tentative taxonomy of the RTDI strategies of foreign firms (which can be extended beyond the case of European economies). The intensity and sources of innovation activities differ markedly across sectors – but inside a given sector, too.
The analysis also highlights different types of academia-industry collaborations, mainly related to the diverse needs of industrial partners, which seem to be closely related to their size (internally available skills and competences) and ownership (access to knowledge and various other resources/ solutions inside their group).
The paper discusses implications for innovation surveys, future quantitative analyses, as well as STI policies, especially for small and medium-sized, open economies, not at the forefront of technological development.

Keywords: Innovation strategies, Sources of heterogeneity: firm- sector- and NIS-level factors, Sectoral and national innovation systems, Business-academia collaboration, STI policy implications

1. INTRODUCTION

This paper, based on interviews conducted on firms' overall business and innovation strategies and innovation activities, is pursuing three interconnected aims:

- better understand firm behaviour by analysing qualitative features of innovation processes (motivations, dynamics, linkages among driving factors and collaboration among actors);
- identify and sharpen hypotheses and research questions for quantitative analyses;
- derive policy implications.

It highlights the findings stemming from interviews conducted on firms' innovation activities in Austria, Bulgaria, Hungary, Poland Slovenia, and the UK, while the detailed results are available in the six country reports. (Balcerowicz [2011], Breitfuss [2010], Bucar [2010], Damianova and Slavova [2010], Havas [2010], Kanellou and Cooke [2010]) Besides, simple statistical analyses are also applied to characterise the national innovation systems of these countries.

The conceptual framework offered by evolutionary economics of innovation, and especially its systems perspective is followed in the paper. This school, together with the triple helix concept, stresses that innovation systems need several elements to operate successfully. Further, the major factor determining the overall innovation performance is not the performance of the individual organisations, but the type, intensity and quality of linkages and co-operation among them. It is also emphasised that STI policies should be devised carefully, in co-ordination with other relevant, but non-STI policy tools, relying on modern decision-preparatory tools, and implemented systematically. (Carlsson *et al*. [2002]; Dodgson, Bessant [1996]; Ergas [1986], [1987]; Etzkowitz, Leydesdorff [2000]; Edquist (ed.) [1997]; Fagerberg *et al.* (eds) [2005]; Foray (ed.) [2009]; Freeman [1987], [1991], [1994], [1995], [2002]; Lundvall (ed.) [1992], Lundvall *et al.* [2002]; Metcalfe, Georghiou [1998]; Nelson [1993], [1995]; Niosi [2002]; Smith [200], [2002])

The paper is organised as follows. To set the scene, a brief overview of the six economies where interviews have been conducted is offered in Section 2. The sample is described and the major interview findings are summarised in Section 3. The concluding section highlights implications for (i) innovation surveys' methods, (ii) further quantitative analyses, as well as (iii) innovation policies and policy analyses.

2. MAIN CHARACTERISTICS OF THE SIX ECONOMIES COVERED

This paper is focusing on the R&D and innovation activities of firms, but it also highlights some major features of the six national innovation systems (NIS) in question.1 These countries are rather diverse in terms of their size (population and GDP), level of economic development, political and economic legacy, macroeconomic performance, economic structure (sectoral composition of the economy, size and ownership structure of firms), market dynamics, the nature of competition, economic policies, decision-making cultures at firm and macro level, corporate governance structures, and other important elements influencing firms' innovation activities (e.g. education system, physical infrastructure for R&D, IPR and other relevant pieces of regulation).

2.1 Size and economic development

Basic data on the size of, and economic development in, the six countries are summarized in Table 1. The biggest of these six countries (the UK), has 30.8 times larger population, and 40.2 times higher GDP than the smallest one (Slovenia). GDP per capita is almost three times higher in the most developed one (Austria: € 29,300 [PPS]; 124% of the EU27 average) than in the least advanced one (Bulgaria: € 10,400 [PPS]; 44% of the EU27 average).

Table 1: Population, GDP and GDP per capita, 2009

	Austria	Bulgaria	Hungary	Poland	Slovenia	UK	EU27
Population (million)	8.4	7.6	10.0	38.1	2.0	61.6	499.7
Population (Slovenia=1)	4.2	3.8	5.0	19.1	1.0	30.8	249.9
GDP (bn €, PPS)	241.3	76.0	148.7	547.3	42.1	1,692.7	11,785.5
GDP (Slovenia=1)	5.7	1.8	3.5	13.0	1.0	40.2	280.2
GDP per cap (€, PPS)	29,300	10,400	15,300	14,300	20,700	26,500	23,600
GDP per cap (EU27=100)	124	44	65	61	88	112	100

Source: Eurostat

It would go beyond the scope of this report even to illustrate the other dimensions of the huge diversity among these countries. However, as already stressed, the principal aim of this paper is to better understand innovation processes at a firm level, that is, not to compare the six economies where the interviews have been conducted. For this purpose, this observed diversity is an asset: innovation processes can be analyzed in different economic and NIS settings.

While country-specific findings on the link between macro level features (size, economic policies, the structure and operation of NIS, framework conditions for innovation) and innovation performance can be found in the individual country reports for the Micro-Dyn project, several general tentative observations – hypotheses for systematic cross-country comparisons – can also be drawn. First, firms operating in large domestic markets are under weaker pressure to internationalize their activities than those in small – or in some cases: tiny – markets, and hence their innovation strategies are also different. Second, the intensity and type of competition also affect firms' innovation strategy to a significant extent. Several Micro-Dyn Working Papers have addressed similar issues, arriving at somewhat differing conclusions on the role of country, sectoral and firm level characteristics, see, e.g. Castellaci [2010]; Dobrinsky and Muraközy [2008]; Halpern (ed.) [2007], [2010]; Srholec and Verspagen [2008].

2.2 Main features of the six NIS

R&D and innovation (RTDI) performance of the six countries is compared in this section, based on set of standard input and output indicators, and innovation performance of businesses.

2.2.1 R&D and innovation performance

Basic comparable data are summarized in Table 2, again revealing a great deal of diversity. (More detailed tables are presented in the Appendix.) Financial resources devoted to R&D (GERD) range from 0.53% to 2.75% of GDP (Bulgaria vs. Austria, while the EU27 average is just above 2%). Given the substantial differences in GDP per capita among these countries, the gap is much wider when expressed in absolute terms: GERD per capita is 37 times higher in Austria than in Bulgaria. In general, the new member states (BG, HU, PL, SI) are behind the EU27 average – and even more so when they are compared to Austria –, but there are significant differences among these countries, too: Slovenia is much closer to the EU27 average than the other three countries.

As for another major input for R&D, that is, human resources, the share of researchers (full-time equivalent) is more than two times higher in Austria and the UK than in Bulgaria or Poland, while Slovenia is above the EU27 average.

Table 2: Main comparable RTDI indicators, 2009

	Austria	Bulgaria	Hungary	Poland	Slovenia	UK	EU27 average[a]
				Total			
GERD as a percentage of GDP (%)	2.75	0.53	1.15	0.59	1.86	1.87	2.01
GERD per capita (€)	903.2	24.3	106.4	47.9	323.2	475.2	473.4
Total FTE researchers per thousand total employment	8.4	3.7	5.3	3.9	7.6	8.4	7.3
				Business enterprise sector			
BERD as a percentage of GDP	1.94	0.16	0.66	0.18	1.20	1.16	1.25
Percentage of GERD financed by industry	44.8	30.6[b]	46.4	29.6	58.0	45.4	54.8
Percentage of GERD performed by businesses	70.6	30.0	57.2	30.9	64.6	62.0	62.1
Percentage of BERD financed by industry	66.3[c]	85.1[b]	71.0	83.1	83.8	69.7	82.4
FTE researchers in business (percentage of national total)	63.2	14.4	44.7	16.7	44.0	34.2	44.3
				Higher Education			
HERD as a percentage of GDP	0.66	0.07	0.24	0.21	0.27	0.5	0.48
Percentage of GERD performed by HEIs	23.8	14.0	20.9	34.9	14.6	26.5	23.7
Percentage of HERD financed by industry	5.7[c]	17.5[b]	15.5	4.0	9.2	4.6	6.8
FTE researchers at HEIs (percentage of national total)	31.9	36.7	30.7	62.3	26.6	60.6	42.1
				Government			
GOVERD as a percentage of GDP	0.15	0.29	0.23	0.20	0.39	0.17	0.27
Percentage of GERD financed by the government	39.1	61.2[b]	42.0	63.7	35.7	30.7	33.9
Percentage of GERD performed by the gov't sector	5.3	55.3	20.1	34.1	20.8	9.2	13.2
Percentage of GOVERD financed by industry	9.3[c]	3.9[b]	12.6	7.3	11.7	7.9	8.2
Government FTE researchers (percentage of national total)	4.4	48.5	24.6	21.6	29.2	3.5	12.4

Source: Eurostat, and author's calculation
Notes: [a] 2009 or the latest available figure; [b] 2008; [c] 2007

There are marked differences in terms of the weight of the three major research performing sectors, too. The business enterprise sector performs 62-70% of GERD in the three more advanced countries (AT, SI, UK), compared to 30% in Bulgaria and Poland. (The EU27 average is 62%). Accordingly, business expenditures on R&D are much higher in the more advanced countries (1.2 – 1.9% of GDP) than in the laggard ones (below 0.2%). (The EU27 average is 1.25%).

The higher education sector is the most important research performer in Poland (35% of GERD performed by HEIs), while the other countries are at the level of the EU27 average (23.7%) or significantly below, namely Bulgaria and Slovenia. In terms of employing researchers, the Polish HE sector is way above the EU27 average (62.3% vs. 42.1%), but this share is fairly high in the UK, too (60.6%).

The weight of the government sector is extremely high in Bulgaria (55.3% of GERD performed, and 48.5% of FTE researcher employed), while 10-14 times lower in Austria and the UK. (The EU27 average is around 4 times lower than the figures in Bulgaria.)

The Summary Innovation Index (SII) takes into account 3 main types of indicators (Enablers; Firm activities; Outputs) and 8 innovation dimensions, capturing in total 25 different indicators. The SII also show a great deal of diversity among the six countries considered: three of them (BG, HU, PL) are way below the EU27 average (0.516), Slovenia is fairly close to that, while Austria and the UK are well above. (Table 3)

Table 3: Summary Innovation Index, 2010

Austria	Bulgaria	Hungary	Poland	Slovenia	UK	EU27
0.591	0.226	0.327	0.278	0.487	0.618	0.516

Source: IUS 2010

The 25 IUS indicators paint a more detailed picture for comprehensive comparisons among these six countries. (Table 4)

Table 4: Innovation Union Scoreboard (IUS) indicators

	AT	BG	HU	PL	SI	UK	EU27
ENABLERS							
Human resources							
1.1.1 New doctorate graduates	2.0	0.5	0.7	0.9	1.3	2.1	1.4
1.1.2 Population completed tertiary education	23.5	27.9	23.9	32.8	31.6	41.5	32.3
1.1.3 Youth with upper secondary level education	86.0	83.7	84.0	91.3	89.4	79.3	78.6
Open. excellent and attractive research systems							
1.2.1 International scientific co-publications	936	190	328	186	750	841	266
1.2.2 Scientific publications among top 10% most cited	0.12	0.03	0.05	0.04	0.07	0.13	0.11
1.2.3 Non-EU doctorate students	8.47	3.97	2.95	2.27	4.64	35.85	19.45
Finance and support							
1.3.1 Public R&D expenditure	0.81	0.36	0.47	0.41	0.66	0.67	0.75
1.3.2 Venture capital	0.029	0.030	0.019	0.043	N/A	0.263	0.110
FIRM ACTIVITIES							
Firm investments							
2.1.1 Business R&D expenditure	1.94	0.16	0.66	0.18	1.20	1.16	1.25
2.1.2 Non-R&D innovation expenditure	0.47	0.95	0.74	1.25	0.79	N/A	0.71
Linkages & entrepreneurship							
2.2.1 SMEs innovating in-house	34.37	17.09	12.60	13.76	N/A	N/A	30.31
2.2.2 Innovative SMEs collaborating with others	14.71	3.50	7.15	6.40	14.24	24.98	11.16
2.2.3 Public-private co-publications	56.3	2.3	19.6	2.5	51.0	61.7	36.2
Intellectual Assets							
2.3.1 PCT patent applications	5.05	0.38	1.54	0.31	2.56	3.51	4.00
2.3.2 PCT patent applications in societal challenges	0.71	0.04	0.39	0.06	0.65	0.73	0.64
2.3.3 Community trademarks	9.56	3.97	2.03	2.82	3.80	4.74	5.41
2.3.4 Community designs	9.19	1.78	0.85	4.71	2.45	2.35	4.75
OUTPUTS							
Innovators							
3.1.1 SMEs introducing product or process innovations	39.55	20.72	16.82	17.55	31.02	25.10	34.18
3.1.2 SMEs introducing marketing/organisational innov.	42.78	17.35	20.52	18.65	39.37	31.06	39.09
Economic effects							
3.2.1 Employment in knowledge-intensive activities	14.04	8.49	12.13	8.87	12.88	16.69	13.03
3.2.2 Medium and high-tech product exports	52.30	26.12	66.43	51.06	58.45	51.85	47.36
3.2.3 Knowledge-intensive services exports	30.90	21.47	28.08	30.60	27.23	67.97	49.43
3.2.4 Sales of new to market and new to firm innovations	11.24	14.20	16.44	9.84	16.31	7.31	13.26
3.2.5 Licence and patent revenues from abroad	0.19	0.02	0.62	0.02	0.08	0.59	0.21

Source: IUS 2010
Note: For the definition of the individual indicators, and the years considered, see also IUS 2010

2.2.2 Innovation activities in the business sector

More firms tend to be innovative in the three advanced countries (AT, SL, UK) in our sample, and the share of the so-called novel and technological innovators is also higher there. Further, a significantly higher share of small and medium-sized enterprises (SMEs) is innovative in these countries than in the other three ones. The share of innovative firms among the large ones, however, is markedly higher in five countries (the exception is the UK, where there is not much difference between the firms belonging to the three size categories). (Tables 5-7)

Table 5: The share of innovative enterprises, 2006-2008 (%)

	Austria	Bulgaria	Hungary	Poland	Slovenia	UK
Small enterprises (10-49 employees)	50.9	25.5	24.5	22.4	44.5	43.0
Medium-sized enterprises (50-249)	70.2	44.6	39.6	40.0	63.4	54.9
Large enterprises (250-)	86.4	69.1	67.1	66.7	89.2	58.3
Total	**56.2**	**30.8**	**28.9**	**27.9**	**50.3**	**45.6**

Source: CIS data (Eurostat)
Note: Innovation activity includes product, process, ongoing or abandoned, organisational and marketing innovations

Table 6: The share of novel innovators (product and process innovators), 2006-2008 (%)

	Austria	Bulgaria	Hungary	Poland	Slovenia
Small enterprises (10-49 employees)	17.0	5.9	5.9	6.6	14.2
Medium-sized enterprises (50-249)	33.0	10.4	10.7	15.6	28.9
Large enterprises (250-)	56.9	21.3	30.2	35.6	58.2
Total	**21.9**	**7.3**	**7.8**	**9.7**	**19.2**

Source: CIS data (Eurostat)
Notes: UK data are not available

Table 7: The share of firms with technological innovation, 2006-2008 (%)

	Austria	Bulgaria	Hungary	Poland	Slovenia
Small enterprises (10-49 employees)	36.8	20.3	16.3	14.3	27.6
Medium-sized enterprises (50-249)	59.0	32.0	31.3	31.6	49.3
Large enterprises (250-)	77.5	59.2	59.2	58.7	81.2
Total	**42.9**	**23.9**	**20.8**	**19.8**	**34.4**

Source: CIS data (Eurostat)
Notes: UK data are not available

IPR activities are widely used proxies for innovation, and hence to judge innovation performance. These activities are also far less intense in the three less advanced countries (BG, HU, PL) in our sample. (Table 4, section "Intellectual assets")

However, at least two arguments should be recalled here as to why one should interpret these figures with a pinch of salt. First, when assessing the performance of NIS in general, one should bear in mind that a wide array of other means can be – and indeed, are – utilized by firms to protect intellectual property, many of which are not captured by measurable or readily available indicators. Moreover, propensity to patenting is highly varied across sectors, and hence the sectoral distribution of a national economy might heavily influence the intensity of patenting activities. Thus, a low level of patenting activities does not necessarily indicate a poor innovation performance. Second, concerning specifically a catching up economy and its NIS, at that stage of development it might not be a meaningful (or feasible) target at all to produce as many patentable R&D results as possible. It seems to be more relevant to concentrate on (a) fostering the diffusion of new technologies and other forms of innovation; and (b) enhancing the learning capabilities for more efficient absorption of new methods and technologies.

2.2.3 Innovation co-operation

There could be a variety of linkages in a successful national innovation system among its players (businesses, academia, intermediary and service providers, policy-makers at various levels). Firms are involved in different ways – formally and informally – and to a varying degree in devising STI policy strategies and actual policy measures. The links between businesses and intermediary organizations (including players offering funds for innovation activities) is also a crucial factor in determining the performance of a given NIS, just as external linkages, that is, the internationalization of RTDI processes and STI policy formation.

A wide variety of knowledge and skills are required for innovation processes to be successful, and these different types of inputs are distributed among various actors. Thus, their co-operation is vital. Community Innovation Survey data indicate that Bulgaria is an 'outlier' in this respect: a mere one sixth of innovative firms are engaged in co-operation, while this ratio is around 40% in Austria, Hungary and Poland, while close to 50% in Slovenia.

As for the type of specific co-operation partners, the most important ones are other businesses (suppliers of equipment, materials, components, or software; clients or customers; competitors or other enterprises in the same sector) in these countries, in line with broader trends. In Austria and Slovenia, however, academia-industry co-operation is also rather frequent, and private R&D labs play an important role too. (Table 8)

Table 8: Share of innovative enterprises* indicating co-operation, 2006-2008 (percentage of all innovative enterprises)

	Austria	Bulgaria	Hungary	Poland	Slovenia
All types of co-operation	38.8	16.6	41.3	39.3	48.0
By specific co-operation partners					
Other enterprises within the enterprise group	17.0	2.8	11.8	9.4	20.2
Suppliers of equipment, materials, components, or software	21.9	10.7	27.5	31.3	41.0
Clients or customers	16.2	9.1	18.6	20.4	35.9
Competitors or other enterprises in the same sector	9.2	5.7	13.1	11.7	24.4
Consultants, commercial labs, or private R&D institutes	14.6	5.0	16.6	10.8	24.2
Higher education organisations	19.6	4.7	18.7	10.7	23.1
Government or public research institutes	7.3	3.9	6.5	9.1	16.9

Source: CIS data (Eurostat)
Notes: * Enterprises with technological innovation (product, process, ongoing or abandoned)
UK data are not available

3 . QUALITATIVE ANALYSIS OF INNOVATION ACTIVITIES: INTERVIEW FINDINGS

3.1 The rationale and motivation to conduct qualitative analysis

Qualitative analysis has been suggested to pursue the guiding principles of Micro-Dyn's WP1 to complement quantitative analysis. Just to recall, innovation is a crucial part of competitiveness and job creation. Given that firms are the major actors in innovation processes, understanding how they innovate is important both for theoretical and policy analyses. As emphasized in the literature, strategies that firms rely upon to create, absorb and exploit knowledge in order to successfully innovate differ a lot across firms, sectors and countries, and getting a better understanding of this pattern as well as its causal underpinnings is central to the research agenda of Micro-Dyn. However, one of the main findings of innovation studies is that firms do not innovate in a vacuum but in close interaction with other players such as customers, suppliers, R&D institutes, etc. From a different angle, various types of knowledge, stemming from diverse sources, are sought by firms to underpin their innovation strategies. It also highlights the important point that innovation strategies cannot be analyzed independently of the broader context that conditions the formation and results of such strategic action.

Until recently, the analysis of the above issues has been hampered by two major factors:

i) the lack of readily available firm level data;
ii) the lack of sufficiently large number of comparable case studies. As for the first obstacle, with the gradually increasing scope and coverage of the Community Innovation Survey (CIS), several relevant variables can be analyzed by processing CIS data. Mcro-Dyn has exploited this rich database for various WPs.

However, it is still important to combine those results with information from other sources, at the firm, sector and country levels, to arrive at a broader, more comprehensive picture. Thus qualitative analyses have been conducted to complement Micro-Dyn's – already pioneering – quantitative analyses to overcome the second obstacle mentioned above. To that end, it has been crucial to conduct a sufficient number of interviews and case studies to reflect the diversity of firms, as well as the impacts of various factors affecting firms' strategies. It is also of paramount importance to align qualitative and quantitative analyses, i.e. to have an appropriate research design.

The qualitative analyses have rested upon the following postulations:

A) The characteristics of national, regional, and sectoral innovation systems play a decisive role in the success of innovation processes, and these qualitative elements thus play a role in determining firms' strategies and their success.

B) Depending on a given firm (its actual strategy, size, sector, ownership, etc.), the "weight" of the national/ regional/ sectoral innovation system might be rather different.

C) Besides the players mentioned above, STI policies (various schemes to promote R&D and innovation, e.g. tax incentives, grants and favorable loans for RTDI projects, information and partnering/ networking services, etc.); regulation on IPR and other relevant issues; education, regional development, competition, investment promotion, trade and other polices; access to capital; the education system; professional associations and chambers are also important elements of an innovation system.

D) The most important feature of a given innovation system, however, is the way in which the respective players communicate, co-operate and compete.

The impact of these factors on firms' strategies and their implementation cannot be analyzed by CIS data alone. Different types of qualitative analyses (literature surveys on national and sectoral innovation systems; interviews with key players, case studies on different types of firms) have had to complement the quantitative analyses performed in the framework of the Micro-Dyn project.

3.2 Methodology and the sample

Desk research has been conducted to identify sectors and types of companies, which are particularly interesting to analyze the factors determining innovation capabilities and competitiveness in the six countries covered. Building on these results, the postulations listed above have been revisited, and interview guidelines have been devised for interviews with firms.

The interview guidelines have addressed three sets of issues:

- Background data on the firm
- Innovation strategy
    - links with overall business strategy of the firm
    - decision-making competences at the interviewed firm
    - internal division of labor
    - main co-operation partners in RTDI activities
    - role and impacts of domestic and EU STI policies
- Successful and abandoned innovations

A fact sheet had been sent – having conducted the interview – to collect background data on the given firm. Companies have been selected to reflect diversity in terms of size, ownership, and R&D and innovation patterns of sectors (e.g. innovation activities of firms relying mainly on intramural or extra-mural R&D activities; extra-mural but "intra-sectorial" R&D activities; "extrasectorial" R&D activities and non-R&D types of knowledge). The samples are described in the country reports. (Balcerowicz [2011], Breitfuss [2010], Bucar [2010], Damianova and Slavova [2010], Havas [2010], Kanellou and Cooke [2010])

3. 3 Main findings stemming from the interviews

3.3.1 Diversity of innovation strategies and activities

In line with the statistical evidence presented in the country reports, the interviews confirmed that *size, ownership and sector matter*. In general, *small, domestic firms* do not have the necessary skills and the required resources to devise innovation strategies, and face business and technological uncertainties in a conscious way. Yet, they are also engaged in innovation activities to improve their performance in order to stay in business or to cease new market opportunities. They are seldom involved in formal(ised) R&D activities or radical innovations; rather they implement incremental innovations to meet new technical specifications. Often these modified products are designed by the buyers – in case of a sophisticated value chain it might be another player in the chain, not necessarily the 'direct' buyer – and the Hungarian supplier adjust its machinery and production processes to be able to manufacture the new product in question. These modifications might not even be regarded innovations by the interviewees because these are not based on advanced R&D activities, leading to radically new technological solutions.

Size can 'overrule' behavioral patterns determined by ownership: a small firm with 20-30 employees, taken over by a geographically distant parent firm is likely to conduct similar type of RTDI activities as an indigenous one. A small firm in the sample had been faced by a new demand from a customer to clean more thoroughly the processed parts following the usual oil treatment. It was not possible by the available machinery, therefore either a new technology (i.e. high-pressure washing technologies), or new detergents were needed to comply with the customer's requirements. Following a thorough survey of potential solutions available on the market (e.g. offers from large chemicals firms), none of them proved financially feasible. The only viable solution was to modify the existing machinery by applying ideas developed in-house – but also approved by the customer. A typical domestic-owned firm would have behaved in the same way. In this case, however, even this technologically minor and relatively inexpensive adjustment required the approval of the parent firm for quality assurance.

These process innovations might require organizational and/or managerial innovations, too, especially in the case of medium-sized firms, where procedures need to be more formalized and the organizational set-up more structured (less flexible) than in the case of small firms with 10-20 employees.

A medium-sized firm in the sample – actually, in 2008, when the devastating impacts of the global crisis was felt only for a few months, it was on the brink to become a large firm – has recently introduced a management information software package (SAP), but some middle managers still prefer using sheets of papers for calculations and keeping records. Thus training is still needed to foster cultural changes. Organizational changes are also being prepared to clearly delineate decision-making competences and responsibilities. A consultancy service is providing professional assistance in bringing about these changes.

Further observations, illustrative cases are to be added

Subsidiaries of foreign firms tend to be at least *medium-sized*, but more often *large* enterprises. They usually organize their RTDI activities in the frame set by the overall business and innovation strategies of the parent firm, which, in turn, are defined by the sectoral patterns to a large extent.

3.3.2 A taxonomy of the role of RTDI activities in the overall business strategy of foreign-owned firms

Earlier research has suggested that for analytical purposes and from the point of view of policy relevance four types of strategies can be distinguished concerning the role and 'weight' of RTDI activities (conducted in a host country) in the overall business models of foreign owned firms. The impacts of these distinct strategies on the national innovation system of the host country, and in particular on the indigenous firms' RTDI activities and learning capabilities would be different. (Havas [2004])

Interviews conducted for the Micro-Dyn project have confirmed this tentative taxonomy, but a fifth type of strategy has also been identified. Several foreign-owned firms have set up R&D units in a host country, and also perform production activities, but these are 'disjoint': R&D activities are mainly conducted as parts of group-level R&D projects, serving the global market, and practically have no connection to other activities serving the domestic market. Taking into account this new finding, a revised taxonomy can be summarised as follows:

1) Narrowly defined efficiency and/ or market seeking FDI with no R&D conducted in the host country

In these cases product innovations are underpinned by R&D activities conducted at other sites – often in the home country – of the investor. Process innovations would also rely on the experience accumulated at other sites, but in the case of brown-field investments domestic skills and knowledge might play a role. As for organizational, 8management and marketing innovations, the main source would be again the codified and tacit knowledge of the foreign managers. These innovation efforts would enhance the productivity of a given site, but hardly any impact can be expected on the other players of the domestic NIS, except for spillover effects, proper.

2) R&D 'contracted out' by the headquarters (without having domestic production activities)

These units conduct R&D projects to cut costs, compensate for the lack of researchers in the home country, or seek other advantages (e.g. faster clinical trials). They are, however, stand alone entities, and in most cases not linked to local R&D institutes or indigenous firms. These units, therefore, have an almost negligible impact on the national innovation system. An important exception is when small Hungarian R&D units of foreign-owned pharmaceuticals firms organise clinical trials: by definition, they must co-operate with local clinics, and in several cases they also co-operated with CROs (contract research organisations).

3) 'Disjoint' domestic production and R&D

These units also conduct R&D projects in the host country to cut costs, compensate for the lack of researchers in the home country, or seek other advantages. These R&D activities are, however, not linked to local production activities. Collaboration with other local R&D institutes or university departments can be observed, as opposed to Type 2) strategies. These units, therefore, might have some noticeable impacts on the national innovation system (e.g. via shaping curricula, offering professional and financial support for PhD programmes).

4) R&D activities to underpin local manufacturing or service activities

Some of these R&D units work exclusively on intra-mural projects, relying on internal knowledge (possessed by the parent firm, developed either in the host or home country or at other sites). Others co-operate with local universities or R&D institutes to exploit external knowledge sources. Obviously, the former ones do not affect the domestic NIS, while the latter ones contribute to joint knowledge generation and exploitation processes.

5) *Deep integration: RTDI efforts for both local and global projects*
These firms – and their R&D units – are engaged in both local and global RTDI efforts and thus have close links with the local knowledge bases, too, bringing them into their international networks. This group is smaller in number than 'type 4' R&D units, and hence their impacts on the NIS should not be exaggerated. Yet, it should not be underestimated, either: their behavioral norms, management methods and the overall mode of operation can have important 'demonstration effects' through their interaction with the local players, and lead to 'learning by co-operation'.

3.3.3 Academia-industry collaboration

Interviews have confirmed that companies and public R&D units (PROs) are driven by fundamentally different incentives to be involved R&D and innovation activities. Hence, there are inherent hindrances to academia-industry collaboration – one of the weak points of the Hungarian NIS, as already discussed in Section 3. In brief, companies are interested in a relatively wide array of R&D activities (from day-to-day problem solving to long-term strategic research), but those lead to business results (enhanced productivity, larger market shares, entry to new markets, increased profits). Thus, tight project management (e.g. meeting, deadlines and 'respecting' budget constraints) and keeping commercially sensible information secret are of vital importance. In contrast, researchers working for universities and other publicly financed research units are not only interested, but even forced to disclose their results. Further, they are less accustomed to tight project management.

Certain types of co-operation have been observed, however. Any research-intensive spinoff firms would naturally co-operate closely with those research units where founders used to work (or still keep a part-time position). Yet, the only firm in our sample has indicated certain frictions in co-operation, given the rigid structures and slow decision-making at the public research institutes.

Almost all medium-sized interviewed firms reported R&D co-operation with universities and/or PROs, especially with those located nearby. In all these cases there has been a pragmatic technical objective – a certain problem to be solved, a new production process to be introduced, etc. –, and a public support measure has also been exploited. (Several Hungarian STI policy measures either make academia-industry co-operation compulsory, or this type of project proposals are given priority.)

Larger firms tend to be more interested in co-operating with universities and PROs on strategic, long-term R&D projects to explore new technological opportunities, reducing both the costs and risks by co-operation. They also support PhD courses financially and/or offering PhD students relevant themes (projects) for their thesis. (A broader form of co-operation is supporting tertiary training by donating modern equipment to universities, and hence making sure that the next generation of engineers and scientists would be familiar e.g. with up-to-date measurement techniques and other relevant instruments.)

In sum, different firms are faced with different needs, and thus pursue different RTDI strategies. Hence, different forms and types of academia-industry co-operation can be observed, with specific goals and activities. STI policies, however, tend to neglect this diversity.

3.3.4 The role of users in innovation

Interviews have also given detailed insights on the decisive role played by users in innovation processes in certain industries (specific software packages, hand tools). This is a thoroughly researched topic, and the findings of these M-D interviews are in line of the literature (see e.g. the works of von Hippel).

3.3.5 The use and impacts of domestic and EU STI policy measures

Interviews suggest a surprisingly low importance of domestic and EU STI policy measures in some of the countries considered – but a caveat is in place immediately: this is a very small, non-representative sample. Several firms, however, have exploited grants offered by these schemes. Practically all cases the project had already been decided; i.e. the scheme in question has not oriented the RTDI activities of a given firm. Moreover, most of these projects would have been conducted without public support, too. In other words, additionality in the narrow sense has been fairly low. More detailed case studies would be needed to establish if additionality in the broader sense – the so-called behavioural additionality – has occurred in any of these cases. (Lipsey and Carlaw [1998]; OECD [2006])

It should be also stressed that consultancy firms specializing in identifying opportunities to obtain public support and drafting project proposals have played a major role in several cases. Without them a number of firms would have not applied for public support. Again, more thorough research, relying on a larger sample, would be needed to draw firm policy conclusions. So far, only diametrically opposite interpretations can be put forward as hypotheses.

A) These firms play a useful role in're-wiring' and revitalizing the Hungarian NIS: they disseminate vital information and build contacts among the interested players more efficiently than the responsible government agencies and other public (non-profit) organizations charged with these tasks.

B) These firms pursue a special rent-seeking strategy, and appropriate some 10-15 of public funds meant to be used for advancing good causes (for the whole society).

3.3.6 Impacts of the global crisis

Our limited sample has suggested significant differences across sectors concerning the impacts of the global financial and economic crisis. Some sectors have been hit particularly hard, e.g. automotive firms, while others have been 'sheltered', given fundamentally different nature of their markets, most notably pharmaceuticals.

More importantly, there has been marked differences in terms of the importance of innovation as a response to the crisis (e.g. devoting more resources to R&D in order to speed up the introduction of new products, cutting costs by process innovations) inside a given sector (ICT).

4. IMPLICATIONS

Several methodological and policy implications can be derived from the qualitative analyses conducted in these six countries.

4.1 Implications for innovation surveys

Several standard questions of innovation surveys might need some revision or more detailed interpretation in 'fast-moving' sectors (e.g. where the main product is changed every year or products tend to have a 3-year life time). In these sectors practically all firms would be innovative ('innovation active') using the current definition of the Community Innovation Survey (CIS). The interviews have pointed to two further possibilities to improve the CIS questionnaire. First, certain firms find it difficult to distinguish between being innovative and creative (especially in the so-called creative industries). Second, a more comprehensible – less vague – definition of organizational innovations would be needed for better measurement and analyses.

Obviously, a more refined terminology would be required to underpin theoretically relevant analyses, which, in turn, can be' translated' into sensible policy conclusions. As a hint towards that direction, more attention would be needed to understand the interplay between the technological and non- technological innovations.

Interviews have also showed that managers have different understanding of innovation (being innovative). In several countries, e.g. in Hungary and Slovenia, it has been crucial to explain the CIS definition in detail in almost all cases: otherwise the respondents would have declared their firm non-innovative. Hence, it would be useful to run a specific project to check the 'validity' and quality of CIS results by establishing how managers who reply to CIS questionnaires understand/ interpret innovation, relying on only the written definition (and not discussing their own cases with an interviewer). This project can only be based on face-to face interviews, and thus would be rather costly. Yet, the opportunity cost – devising policy measures based on false information – is likely to exceed these costs significantly.

Our sample also suggests that there might be major differences in this respect across countries (more developed ones, in general, and having accumulated more experience with running CIS and analyzing its results [e.g. Austria] vs. less developed ones and/ or less experienced ones), as well as among firms (with different level of R&D and innovation intensity, and/ or managerial skills). To reflect this diversity, a sufficiently large sample would be needed.

4.2 Implications for quantitative analyses

In case of 'disjoint' R&D and production (when there is no link between R&D projects conducted in the host country and the subsidiary's economic performance) the unit of analysis cannot be the local subsidiary. It would be important to establish to what extent this phenomenon would influence ('distort') the results of econometric analyses at a macro or industry level.

Using the Hungarian case as an illustration, this issue is not negligible. One sector concerned by this matter is pharmaceuticals, that is, by far the largest R&D spender (46.1% of manufacturing BERD in 2007). Another one is the "manufacture of radio, television and communication equipment and apparatus", with also a considerable share in manufacturing BERD (11.6% in 2007, ranked third among the manufacturing sectors).

Interviews have also pointed to some cases where R&D is conducted by R&D units or R&D service providers in the host country, that is, not by a given subsidiary, and financed directly by its parent firm (e.g. in the case of some clinical trials carried out in Hungary). While subsidiaries play a decisive role in opening these opportunities for domestic RTDI actors, these R&D expenditures are not reported in the host country (as these should be reported in the home country). The overall impacts of foreign subsidiaries on the national innovation system of the host country, therefore, might be underestimated when relying exclusively on econometric analyses of census data and R&D surveys.

4.3 Implications for policy analyses, policy actions and firm strategies

Several issues, stemming from the qualitative analyses conducted for the Micro-Dyn project, are needed to be considered by policy analysts, policy-makers, and managers.

4.3.1 Framework conditions for innovation – the impacts of STI policies

A detailed analysis has explored several factors, which can explain an intriguing puzzle observed in Hungary: there are a large number of apparently relevant policy schemes to foster R&D and innovation activities, and yet, innovation performance is rather poor. (Havas [2008], [2009]) Six potential explanations have been considered:
a) STI policy measures are not co-ordinate with the broad objectives of an overall socio-economic development strategy;
b) STI policy goals are not tailored to the needs to be addressed;
c) STI funds are insufficient;
d) the available funds are spent in an inefficient way;
e) STI policy measures are not evaluated regularly, and hence lessons cannot be learnt and the measures cannot be improved; and finally,
f) the so-called framework conditions are unfavorable for innovation.
This analysis has concluded that that several of these factors should be combined for a plausible explanation, while some of them can be rejected. The most important one of these factors, however, points outside the narrowly defined STI policy domain: the general framework conditions for innovations seem to play a decisive role. These conditions influence firms' innovation activities with such a power that STI policy schemes cannot offer strong enough incentives to overrule their unfavorable effects.

To generalize this finding, devising appropriate STI policies and implementing them in an efficient and effective way might not be sufficient to improve RTDI performance: favorable framework conditions – notably a stable macroeconomic environment; endurable administrative and tax burdens on firms; market conditions conducive to innovation; a sufficient supply of skilled people for RTDI projects; appropriate regulations and standards; effective IPR policies; etc. – are also needed. Thus, policy goals set in different domains affecting these conditions should be aligned with STI policy efforts to make a difference.

4.3.2 Policies vs. internationalization of firms' activities

Given the current level of internationalization of RTDI and business activities, policy-makers need to thoroughly consider to what extent national economic and other policies can affect firms' activities. In particular, two types of firms require attention: those belonging to global production and innovation networks (in short, integrated firms, regardless of their ownership), and foreign-owned firms.

In the case of integrated firms –most prominently in ICT hardware sectors, and automotive industry, but increasingly in other sectors, too – major investment, production, and sales decision are heavily influenced by the network dynamics in general, as well as long-term contracts, in particular. Thus, economic policies – e.g. fiscal, monetary, industrial, investment promotion, regional development, labor market measures – aimed at steering businesses need to be based on a deep understanding of network dynamics, and devised by taking into account the strategies of the network integrators. Otherwise, these policies are unlikely to reach their desired effects (in spite of spending public money), or could even lead to adverse effects.

As for subsidiaries of foreign firms, their RTDI activities are driven by the overall and RTDI strategies of their parent firms even in advanced economies, e.g. Austria, and it is even more so in less advanced economies, where subsidiaries are likely to have a minor influence on their parent firms' strategies, if at all. Hence, policy-makers need to be aware that domestic STI policies can only have limited impacts on the behavior of this group of firms. Further, they should be careful in targeting public support. Foreign firms are rarely set up an R&D unit in a host country simply because of cost advantages: strategic 'fit', excellence of available human resources and potential RTDI co-operation partners are the decisive factors in these decisions. Therefore, it seems wiser to use public money to improve the performance of the domestic players of a given innovation system (national, sectoral, or regional), making them attractive partners for foreign firms, rather than offering unnecessary "sweeteners" for these investments.

Of course, devising effective and efficient policies in this domain is not a trivial task. First, it takes time to significantly improve the performance of an innovation system, and S&T and business dynamics might be faster processes than policy processes (especially in terms of impacts on performance). Second, foreign firms, once decided to set up an R&D unit on the basis of the factors mentioned above, might also try to push the government of the host country to offer subsidies tailored for them, by threatening that they would set up that R&D unit in another country. Again, a thorough understanding of these dynamics is crucial.

A tentative taxonomy of foreign firms' RTDI strategies has been devised drawing on interviews. One of these, called 'disjoint' domestic production and R&D, that is, when R&D activities are not linked to local production, requires special attention from policy-makers. They need to consider why, in which ways, and to what extent to promote these 'disjoint' R&D activities, conducted for advancing the MNCs' strategies. It is not obvious – at least at the first glance – what policy rationale could justify and guide these measures, and to what extent it would be beneficial for the public.

4.3.3 Industry-academia collaboration

Interviews have also revealed that (i) motivations, incentives for, and norms of, conducting RTDI activities diametrically differ in business and academia (higher education and PROs); and (b) different types of firms have different needs. Thus, a strong case can be put forward for more refined measures to promote industry-academia collaboration, better tuned to the needs of the actors (based on a relevant taxonomy of this type RTDI collaboration).

Further, evaluation criteria for academics should also be revised to remove some major obstacles, currently blocking more effective industry-academia co-operation. Obviously, it would require sound analyses of a given higher education system, and then a thorough decision-preparatory process because quite naturally a fierce opposition is likely to arise from academics, given strong traditions at universities and PROs.

4.3.4 High-tech sectors vs. knowledge-intensive activities

An important policy lesson can be drawn from the distinction between the so-called high-tech sectors vs. knowledge-intensive activities. STI policies aimed at promoting innovation and hence competitiveness should focus on the actual activities performed, rather than confusing them with the OECD classification of sectors. More precisely, four levels should be distinguished: activities, products, firms, and sectors. Firms belonging to the same statistical sector might possess quite different capabilities, e.g. innovation, production, management, marketing and financial ones. Further, they are unlikely to produce identical goods, e.g. in terms of skills and investment requirement, quality, market, and profit opportunities. Finally, they perform different activities, especially in their knowledge-intensity. These dissimilarities are likely to be even more pronounced when we analyze sectors, firms, products, and activities across different national systems of innovation and production. In short, the performance of heterogeneous firms cannot be improved by uniform policy approaches. No doubts, it sounds elementary; yet policy-makers tend to prefer 'broad', general policy tools: they are less willing to pay attention to the above crucial differences among firms in the same statistical sector, and thus even less ready to devise and operate differentiated schemes.

Even highly respected scholars could make this mistake, as pointed out by Archibugi [2001], when commenting on Pavitt's classic taxonomy of innovating firms: "… the taxonomy is devoted to classifying firms and not industries (…). Unfortunately, Pavitt himself has failed to make this aspect clear: in his 1984 article, as well as in his further developments, Pavitt has grouped in each category of his taxonomy data at the *industry* and not at the *firm* level. This is a major limitation since it is well known that firms which have for convenience been grouped together into an industry on the basis of their main output may have a very different technological base: both slippers and moon-boots belong to the footwear industry, but the technology-intensity of the two products is very different (…)." (p. 419). This example should not be dismissed as a witty, but extreme, and thus irrelevant remark. Indeed, the author also shows that this seemingly small, unimportant mistake may "… lead to wrong policy advice; suppose that a government (…) makes an attempt to foster innovation by using different incentives for each group of firms. If selectivity criteria are applied on the basis of industry to which a firm belongs it is likely that a substantial part of incentives to innovation will be misplaced: for example, moon-boot manufacturers may receive incentives to purchase specialised machinery [as follows from Pavitt's taxonomy for footwear companies – A.H.] rather than to finance their in-house R&D." (p. 420)

4.3.5 STI policies and R&D-intensive SMEs

State funds for RTDI projects might have adverse affects on SMEs' performance for two reasons. First, subsidies might reach such a scale that providing the required own funding (typically 50 of the total budget of a given project) would pose a major challenge. Second, subsidized projects focusing on R&D (and neglecting innovation) can easily divert the managers' attention from business objectives (turning R&D results into profitable goods or services, running the other activities of the firm successfully, etc.). It is particularly important in those cases where enthusiastic researchers would incline devoting significant time and efforts to solve interesting, and socially relevant, research problems, which are unlikely to lead to marketable products or services (e.g. software solutions in the field of cultural heritage, broadly defined).

Hence, managers of R&D-intensive SMEs need to be careful when allocating financial and human resources between subsidized R&D projects, market-driven innovation efforts, and day-to-day business activities.

Policy-makers, in turn, might want to consider introducing a more refined system of support measures, in which the share of required financial contribution from the supported organizations would depend not only the type of the organization (businesses vs. academic R&D units), but also on the activities pursued (projects aimed at solving market-driven vs. socially relevant problems).

A special case of R&D-intensive SMEs are spin-off companies. They are faced with major challenges in several countries, including heavy regulatory and social security burdens, difficulties in receiving external funding, operating under the ownership of universities or PROs with a different – not business friendly – management culture, as well as the complicated, cumbersome nature of public R&D support measures.

Policy-makers need to remove these obstacles – but it is also important to avoid the hypes related to the "miracles" expected from supporting venture capital funds and academic spinoffs (or more broadly, new technology based firms).

REFERENCES

AIPM [2006]: Newsletter 2006/1, Association of the Innovative Pharmaceuticals Manufacturers, www.igy.hu

Archibugi, D. [2001]: Pavitt's Taxonomy Sixteen Years On: A review article, *Economics of Innovation and New Technology*, **10** (5): 415-25

Balcerowicz, E. [2011]: Diversity in Firms' Innovation Strategies and Activities in Poland, paper prepared for the Mycro-Dyn project

Breitfuss, M [2010]: Diversity in Firms' Innovation Strategies and Activities: Main findings of interviews and implications in the context of the Austrian national innovation system, paper prepared for the Mycro-Dyn project

Breschi, S., Lissoni, F. [2001]: Knowledge Spillovers and Local Innovation Systems: A Critical Survey, *Industrial and Corporate Change*, **10** (4): 975-1005

Bucar, M. [2010]: Diversity & Similarities in Firms' Innovation Strategies and Activities: Main findings of interviews and implications in the context of the Slovenian national innovation system, paper prepared for the Mycro-Dyn project

Carlsson, B., Jacobsson, S., Holmén, M., Rickne, A. [2002]: Innovation systems: analytical and methodological issues, *Research Policy*, Vol. 31, No. 2, pp. 233-245

Castellaci, F. [2010]: Firm heterogeneity, international cooperations and export participation, *Micro-Dyn Working Paper* no. 26/10

Clausen, T. [2008]: Firm heterogeneity within industries: How important is "industry" to innovation?, *Micro-Dyn Working Paper* no. 09/08

Damianova, Z., Slavova, M. [2010]: Diversity in Firms' Innovation Strategies and Activities: Main findings of interviews in Bulgaria, paper prepared for the Mycro-Dyn project

Damijan, J.P., Knell, M., Majcen, B., Rojec, M. [2003]: Technology Transfer through FDI in Top-10 Transition Countries: How Important are Direct Effects, Horizontal and Vertical Spillovers?, University of Michigan Business School, *William Davidson Working Paper* No. 549

Dodgson M., Bessant J. [1996]: *Effective Innovation Policy: A new approach*, New York: Routledge

Dobrinsky, R., Muraközy, B. [2008]: Industrial policy, innovation and competitiveness, *Micro-Dyn Working Paper* no. 04/08 EC [2010a]: *European Competitiveness Report 2009*, Luxembourg: Publications Office of the European Union [doi: 10.2769/21563]

EC [2010b]: *European Competitiveness Report 2010*, Commission Staff Working Document, SEC(2010) 1276 final, Brussels, 28 October 2010

EC [2010c]: Fifth report on economic, social and territorial cohesion, Luxembourg: Publications Office of the European Union [doi: 10.2776/29620] Edquist, C. (ed.) [1997]: *Systems of Innovations: Technologies, institutions and organizations*, London: Pinter

Ergas, H. [1986]: Does Technology Policy Matter?, Centre for European Policy Studies, *CEPS Papers*, No. 29, Brussels

Ergas, H. [1987]: The importance of technology policy, in: Dasgupta, P., Stoneman, P. (eds): *Economic Policy and Technological Performance*, pp. 51-96, Cambridge: Cambridge University Press

Etzkowitz, H., Leysdorff, L. [2000]: The dynamics of innovation: from National Systems and 'Mode 2' to a Triple Helix of university-industry-government relations, *Research Policy*, Vol. 29, No. 2, pp. 109-123

Eurostat [2005]: *Panorama of the European Union, European Business Facts and Figures 1995-2004*, http://epp.eurostat.cec.eu.int/portal/

Eurostat [2009]: *European Business: Facts and Figures*, http://epp.eurostat.ec.europa.eu/portal/page/portal/product_details/publication?p_product_code=KS-BW-09-001

Fagerberg, J., Mowery, D.C., Nelson, R.R. (eds) [2005]: *The Oxford Handbook of Innovation*, Oxford: Oxford UP

Foray, D. (ed.) [2009]: *The New Economics of Technology Policy*, Cheltenham: Edward Elgar

Freeman, C. [1987]: *Technology and Economic Performance: Lessons from Japan*, London: Pinter Publishers

Freeman, C. [1991]: Networks of innovators, a synthesis of research issues, *Research Policy*, Vol. 20, No. 5, pp.499-514

Freeman, C. [1994]: The economics of technical change: A critical survey, *Cambridge Journal of Economics*, Vol. 18, No. 5, pp. 463-514

Freeman, C. [1995]: The 'National System of Innovation' in historical perspective, *Cambridge Journal of Economics*, Vol. 19, No. 1, pp. 5-24

Freeman, C. [2002]: Continental, national, and sub-national innovation systems – complementarity and economic growth, *Research Policy*, Vol. 31, No. 2, pp. 191-211

Godin, B. [2004]: The obsession for competitiveness and its impact on statistics: the construction of high-technology indicators, *Research Policy*, **33** (8): 1217-1229

Halpern, L. (ed.) [2007]: Literature survey on the links between innovation, competition, competitiveness, entry & exit, firm survival and growth, *Micro-Dyn Working Paper* no.02/07

Halpern, L. (ed.) [2010]: Competition, innovation and firm performance in EU member states, *Micro-Dyn Working Paper* no. 37/10

Havas, A. [2004]: Strategic Moves of MNCs and their Impacts on Local Learning and RTDI Capabilities: Traps and opportunities for Central European countries, presentation at an UNCTAD Seminar on *FDI in tradable services in Central and Eastern Europe*, Budapest, 5-6 March 2004

Havas, A. [2008]: Broad Set of STI Policy Measures – Poor Innovation Performance: Lessons from a Central European country, paper presented at the *Europe-Latin America Conference on Science and Innovation Policy*, held on September 24-26, 2008, Mexico City

Havas, A. [2009]: Magyar paradoxon? A gyenge innovációs teljesítmény lehetséges okai, (A Hungarian Paradox? On the potential reasons for a poor innovation performance), *Külgazdaság*, **53** (9-10) 74-112

Havas, A. [2010]: Diversity in Firms' Innovation Strategies and Activities: Main findings of interviews and implications in the context of the Hungarian national innovation system *Mycro-Dyn Working Paper* 16/10

Hollander, H., Tarantola, S. [2011]: Innovation Union Scoreboard 2010 – Methodology report, Pro Inno Europe, Inno Metrics

IRIS [2008]: *Monitoring industrial research: The 2008 EU Industrial R&D Investment Scoreboard*, Seville: EC JRC IPTS, http://iri.jrc.ec.europa.eu

IRIS [2009]: *Monitoring industrial research: The 2009 EU Industrial R&D Investment Scoreboard*, Seville: EC JRC IPTS, http://iri.jrc.ec.europa.eu

IUS [2010]: The Innovation Union's performance scoreboard for Research and Innovation, Pro Inno Europe, Inno Metrics

Kanellou and Cooke [2010]: Country Report UK, paper prepared for the Mycro-Dyn project

Langlois, R.N., Robertson, P.L. [1996]: Stop Crying over Spilt Knowledge: A Critical Look at the Theory of Spillovers and Technical Change, *Working papers* 1996-06, University of Connecticut, Department of Economics

Lipsey, R.G., Carlaw, K. [1998]: Technology policies in neo-classical and structuralist evolutionary models, *STI Review*, No. 22, pp. 31-73

Lundvall, Bengt-Åke (ed.) [1992]: *National Systems of Innovation: Towards a theory of innovation and interactive learning*, London: Pinter

Lundvall, B-Å, Johnson, B., Andersen, E.S., Dalum B. [2002]: National systems of production, innovation and competence building, *Research Policy*, **31** (2): 213-231

Metcalfe, , S.J., Georghiou, L. [1998]: Equilibrium and evolutionary foundations of technology policy, *STI Review*, No. 22, pp. 75-100, Paris: OECD

Mowery, D.C., Nelson, R.R. (eds) [1999]: *Sources of Industrial Leadership, Studies of Seven Industries*, Cambridge: Cambridge University Press

Nightingale, P., Martin, P. [2004]: The myth of the biotech revolution, *Trends in Biotechnology*, **22** (11): 564-569

Nelson, R.R. (ed.) [1993]: *National Innovation Systems: A comparative study*, New York: Oxford University Press

Nelson, R.R. [1995]: Recent evolutionary theorizing about economic change, *Journal of Economic Literature*, Vol. XXXIII, No. 1, pp. 48-90

Niosi, J. [2002]: National systems of innovation are 'x-efficient' (and x-effective): Why some are slow learners, *Research Policy*, **31** (2): 291-302

OECD [2006]: *Government R&D Funding and Company Behaviour: Measuring behavioural additionality*, Paris: OECD

OECD [2008]: *OECD Reviews of Innovation Policy: Hungary*, Paris: OECD

Pavitt, K. [1984]: Sectoral patterns of technical change: towards a taxonomy and theory, *Research Policy*, **13** (6): 343-373

Smith, K. [2000]: Innovation a s a Systemic Phenomenon: Rethinking the Role of Policy, *Enterprise & Innovation Management Studies*, Vol. 1, No. 1, 73-102

Smith, K. [2002]: What is the ‘Knowledge Economy’? Knowledge intensity and distributed knowledge bases, *UNU/INTECH Discussion Paper Series*, 2002-6

Smith, Keith [2005]: Measuring Innovation, in: Fagerberg, Jan, David C. Mowery and Richard R. Nelson (eds): *The Oxford Handbook of Innovation*, Oxford: Oxford UP

Srholec, M. [2006]: Global Production Systems and Technological Catching up: Thinking twice about high-tech industries in the emerging countries, in: Piech, K., Radosevic, S. (eds): *The Knowledge-Based Economy in Central and East European Countries: Economies and industries in a process of change*, Basingstoke: Palgrave

Srholec, M., Verspagen, B. [2008]: The Voyage of the Beagle in Innovation Systems Land: Explorations on Sectors, Innovation, Heterogeneity and Selection, *Micro-Dyn Working Paper* no. 03/08

STRENGTHENING NATIONAL INNOVATION POLICIES IN DEVELOPING COUNTRIES: NEW APPROACHES FOR ANALYSING NATIONAL INNOVATION SYSTEMS IN EMERGING AND DEVELOPING COUNTRIES – ANIS

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Abstract
The following paper presents a tool for the indicator-based analysis of (national) innovation systems (ANIS), which identifies economic strengths and weaknesses of a country, region or local system. ANIS was developed by the Institute for Innovation and Technology, Berlin (iit). It includes a comprehensive examination and evaluation of the status of existing innovation systems. The specific form of expert interviews at macro, meso and micro level provides a detailed image of a national, regional or local economy. It is mainly intended for emerging and developing countries for which standard innovation benchmarking and monitoring approaches might not be sufficient as often the statistical data is missing or outdated. The ANIS approach provides a quick and comprehensive picture of the main scope of interventions to improve specific determinants of an innovation system. As a result of these findings, specific policy measures addressing these determinants can be formulated. Policy makers can thus benefit from clear advice with regard to overcoming weaknesses within their innovation system and to identifying those determinants that should receive special attention. As example the analysis of the local innovation system of Manaus (Brazil) is presented in this paper.

Keywords: National Innovation Systems; Analysis; Indicators; Policy Recommendations

1. Introduction

2.1. 1.1 Why another tool to analyze innovation systems?

When interviewing policy makers in emerging and developing countries about possibilities for stimulating innovation within their economy, it often becomes apparent that they look for structured descriptions of their innovation systems and clear recommendations for improving the performance thereof. Rather than asking for scientific models of the functionality of the innovation system or for sophisticated, statistically based performance indicators, they are more interested in the practical assessment of their economic environment with regard to innovation.

Indeed, some existing analyses of the conditions for innovation may overwhelm policy makers as they do not provide clear guidelines for improvement. These reports lack precise recommendations on how to optimize the effects of innovation capacities particularly in an environment where the resources for public investment are limited. It is therefore crucial to identify those determinants of an innovation system, which can be improved with the tools and financial means available for third party donors.

ANIS ("Analysis of National Innovation Systems") provides a comprehensive examination and evaluation of the status of existing national, regional or local innovation systems. It is in line with the new approach of indicator-based studies relying on quantitative data generated by the evaluation of expert interviews. The concept, which was developed by the Institute for Innovation and Technology (iit) in Berlin [1], differs from traditional benchmarking studies on innovation performance, such as the Global Competitiveness Report, the European Scoreboard or the Nordic Innovation Monitor. All of them are excellent means for measuring and benchmarking innovation-related performance indicators. However, the Nordic Innovation Monitor is rather intended for well-matured economies than for developing or emerging countries' issues as the statistical base for these countries often proves to be insufficient. The Global Competitiveness Report uses a mix of statistical data and expert interviews. Yet, since it focuses on the competitiveness of nations, the issue of innovation is not sufficiently resolved.

Besides providing the statistical analysis ANIS also transfers knowledge among the participating parties. This is ensured through a division of labor between the analytical ANIS-expert and one, two or more local experts in the respective country or region who learn the ANIS approach and support the conduction thereof. As such a “train-the-trainer” approach develops individually for each country or region that is analyzed. This leads to collaboration at equal level.

1.2 The relevance of measuring innovations systems for growth and economic success particularly in developing countries within the Triple Helix interactions

With regard to the triple helix concept, ANIS allows the representation of all actors of the innovation system of a country. With ANIS it is possible to connect the views and opinions of universities, institutional support and industry in order to enable them to put themselves in the other’s place (which is one of the main aims of the triple helix concept in order to critically reflect on conventional views). During the analysis the representatives of each level receive a good insight-view of their innovation system, a self-assessment that stimulates mutual discussion among the stakeholders, an evaluation that does not only distinguish between “good” or “bad”, instead an assessment of the maturity of the determinants, clear recommendations for activities to improve the country’s innovation system with high impact and relatively small time and effort.

As such, the ANIS tool can provide the basis from which policy measures with a long-term impact on the national innovation system can be derived.

2. State-of-the-art of analytical tools for measuring the maturity of innovation systems

Measuring the maturity of innovation systems has been the focus of many scientific efforts in order to rank countries according to their innovative capacity. Among these efforts are general economic reports as mentioned above.

All of them have developed variables on which the maturity of the innovation system is dependent. However, as Belitz et al. [2] have stated by referring to Patel & Pavitt [3] “[t]here is consensus that an ideal ‘catch all’ variable for innovation is not at hand”. Furthermore, it is emphasized by Belitz et al. that these rankings are however necessary to give a good basis on which policy makers can base their decisions. Furthermore, Belitz et al. emphasize that in depth analyses limit the database of countries since the in depth indicators are only available for a few countries. Many debates about analytical tools mention the integration of soft factors (e.g. evaluating possible future scenarios) to be able to provide in depth analyses. Only a few analytical tools can meet these requirements when it comes to emerging and developing countries. Among them is ANIS.

Belitz et al. state that the analysis of national innovation systems can be divided into two approaches. On the one hand there is the descriptive method based on case studies, as introduced by Nelson [4]. On the other hand there is the theoretical approach based on secondary research and quantitative indicators, as presented by Lundvall [5]. Both approaches share the characterization of national innovation systems by determinants of innovation processes.

ANIS provides a comprehensive examination and evaluation of the status of existing national innovation systems. It is in line with the new approach of indicator-based studies relying on quantitative data generated by the evaluation of expert interviews. The concept differs from the traditional benchmarking studies on innovation performance mentioned above. All of them are excellent means for measuring and benchmarking innovation-related performance indicators. However, the Nordic Innovation Monitor is rather intended for well-matured economies than for developing or emerging countries' issues as the statistical base for these countries often proves to be insufficient. The Global Competitiveness Report uses a mix of statistical data and expert interviews. Yet, since it focuses on the competitiveness of nations, the issue of innovation is not sufficiently resolved.

3. Methodology

1.1 Scope and Demarcation

ANIS can be understood as a quick scan of the maturity of the main determinants of an innovation system. It focusses on determinants that can influence an innovation system with qualitative and quantitative research. Through expert opinion surveys with national stakeholders of the macro, meso and micro level preferably in peer assessment groups the exchange of ideas with regard to future developments of the country’s or region’s economy are developed.

In a way the ANIS approach shares similarities with the Delphi-method. This forecast technique, described in detail by Wolf, Zerres & Zerres [6] is a qualitative research method that is often used to specify the quantitative research that has taken place most often prior to further in-depth analyses. Especially when developing new ideas and concepts, the Delphi-method is of help, as it captures group opinions which then provide sufficient "data" to formulate forecasts from which policy recommendations can be derived.

3.2 Background: The three level hierarchy of an innovation system

The ANIS approach is based on the assumption that an innovation system is mainly influenced, at national level, by 30 determinants. ANIS takes up this challenge by providing an indicator-based assessment of these determinants, each of which reflects an aspect of the innovation system. The determinants may be grouped according to a three level hierarchy which can be described as follows:

- Macro Level: Innovation Policy Level

In macro-dimension, national innovation policies directly influence the framework conditions of an innovation system. Laws, decrees and regulations at that level may often be path breaking, in a positive or a negative way. Public investment in innovation directly relies on decisions made at a policy level. However such political decisions may only influence the framework conditions for innovation and might not turn innovation into practice.

- Meso Level: Institutional Innovation Support Level + Programmatic Innovation Support Level

Institutions operating at meso level are typically technology transfer centers, clusters, innovation service providers and funding agencies. They may be considered as the relevant tools to turn any political decision regarding innovation into practice. In developing and emerging countries such institutions are mostly publicly-owned. These institutions remain a key instrument for improving and encouraging the innovation capabilities of firms, especially in countries where public investment is limited.

Programmatic innovation support includes public funding programs and initiatives which aim at turning innovation policy into practice. Such programs might be managed either by policy makers or by innovation support institutions. Any measures at that level would require significant public investments.

- Micro Level: Innovation Capacity Level

The micro level provides an umbrella for the main actors and enablers within an innovation system such as enterprises (large, medium, small, and micro), entrepreneurs, universities, public or private R&D institutions, innovators or financial organizations.

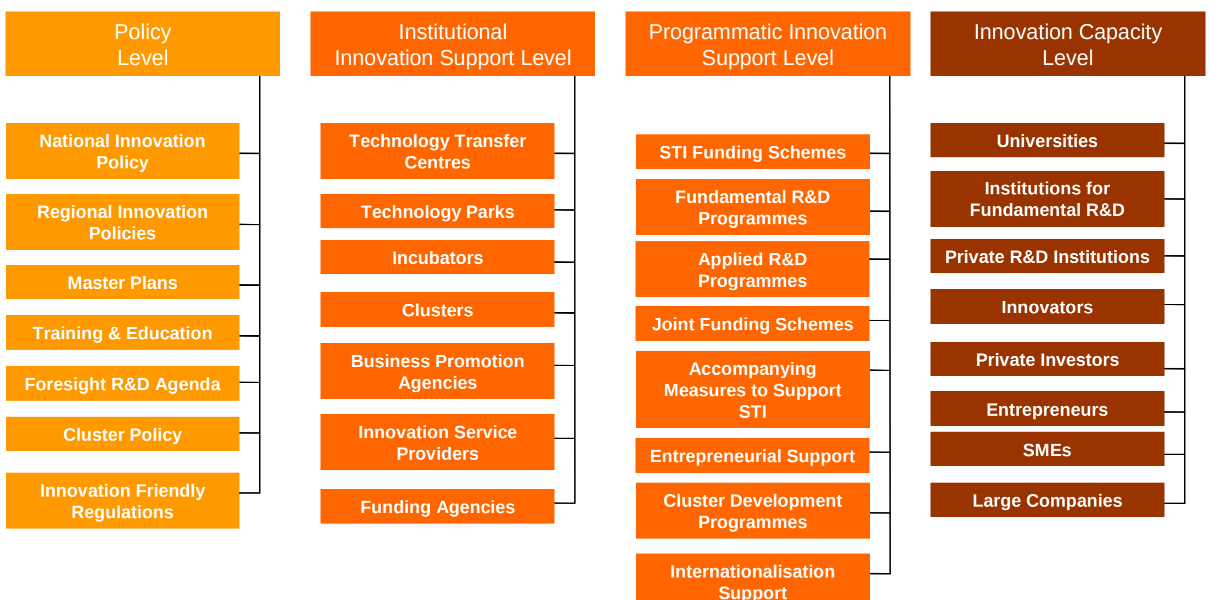

Fig.1. The 30 determinants of an innovation system [7]

The 30 determinants' level classification is shown in the figure 1. A comparison between the determinants of these different levels allows the identification of key policy areas requiring a potential intervention to strengthen the innovation system.

The maturity level of an innovation system as well as the performance of its actors may be improved by means of policy measures addressing either individual determinants or groups. As the determinants are often linked to each other the degree of improvement can even increase and leave a higher impact in the entire innovation system.

The overall implemented ANIS approach of analyzing an innovation system consists of the following steps: (1) Analyzing of existing literature regarding the innovation system, (2) Conducting interviews with experts regarding the innovation system, (3) Filling in the expert opinion survey in expert peer groups, (4) Evaluating and measuring of the outcomes (5) Identifying determinants having a high impact with little costs, (6) Formulating recommendations to improve the prioritized determinants.

3.3 Identifying the Determinants of Innovation Systems

The different levels may be influenced by the determinants shown in figure 1. They can be improved with appropriate measures. Although the four levels are analyzed separately, it is acknowledge that there are plenty of interdependencies and links between them. Each of the determinants may influence an innovation system differently. In the short term, some of them would only require low input whereas others would need longer periods of time for improvement, combined with significant investment. Improving any determinant might generate magnified positive impacts.

A set of three to five questions for each determinant was designed in order to characterize each of the 30 determinants properly and assess their stage of development.

3.4 Expert Opinion Survey (EOS)

The implemented model relies on a wide range of survey data from the Expert Opinion Survey (EOS). The EOS meets the need for up to date and far reaching data thus providing valuable qualitative information which is scarce or nonexistent from hard data sources. The 30 determinants are calculated by considering more than 100 variables which are based on the findings of the EOS for each respective country or local environment.

The experts are asked to provide their opinions regarding various aspects of innovation and the innovation environment they operate in. The relevant data which is gathered as a result of such interviews offers a detailed insight and qualitative portrait of each country's or region's concept of innovation and each country's/region's own representation of its situation in comparison to others.

3.5 Rating

Through the survey process the interviewees are asked to rate the current conditions of their country's innovation environment on a scale from 1 to 4. On the scale, rating 1 corresponds to the worst operating condition or situation. Rating 4 corresponds to the best operating condition or situation. The ratings in between indicate the tendencies to either positive or negative evaluation. If a condition is not existent at all, the interviewee shall rate it as zero. If the interviewee does not know anything about the condition, he/she shall answer "I don't know".

3.6 The indicator approach

Based on the findings of the EOS and on the evaluation of the questions the appropriate indicators are calculated. A scale with the following indicators was designed:

- Indicator "1" represents the determinant at its worst operating condition or situation, emphasizing that it is poorly developed.
- Indicator "2" means that a determinant basically exists and has shown first positive impacts. Nevertheless, there is a strong need to improve its efficiency or functionality.
- Indicator "3" means that a determinant is mature and has shown positive impact on the performance of the innovation system over a long period of time. Nevertheless there is still room for further improvement to reach excellent performance.
- Indicator "4" corresponds to the determinant which is at its best operating condition. Although small improvements might still be possible, this determinant has proved to be strongly developed and well performing over a long period of time.

Figure 2 exemplifies the maturity of the determinants of the innovation capacity level in Manaus, Brazil as evaluated by the respective experts in their opinion surveys. This figure helps to demonstrate differences between the opinions of the representatives of each level and to stimulate mutual discussion among them. More details on the Manaus, Brazil are to be found in chapter 4.

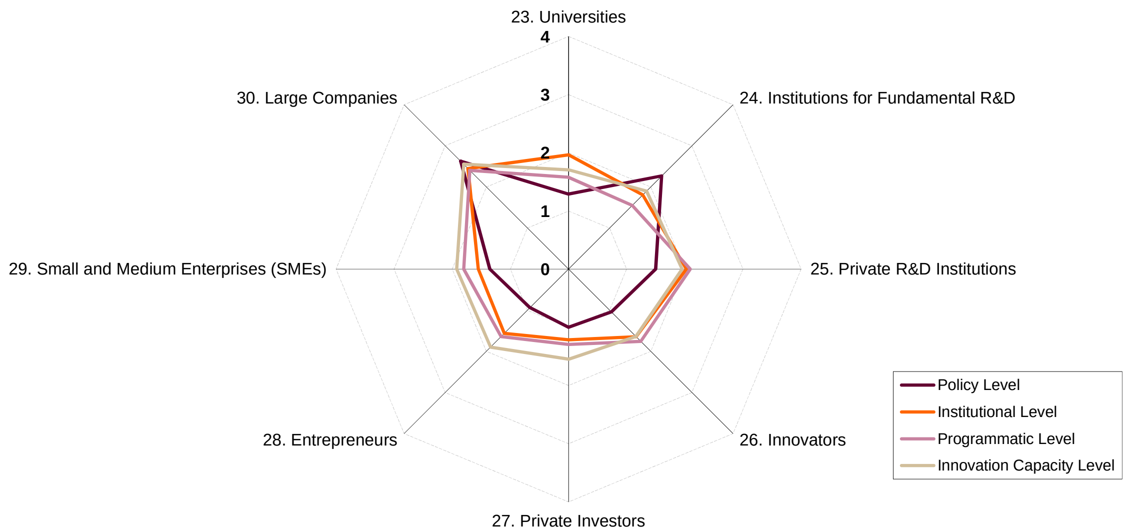

Fig.2. The determinants of the innovation capacity level evaluated by the representatives of the innovation system of Manaus, Brazil. [8]

3.7 Analysis and comparative portfolio

In order to analysis the current status of the innovation system the country that has been analyzed is benchmarked against other countries whose economies are on a comparable level. Thus, a comparative portfolio is used to evaluate the country's economic status.

This comparative portfolio, which is an integrated element of the ANIS approach, against which the determinants of the innovation system are benchmarked, consists of the corresponding data of countries having similar comparative economies. For this, the classification based on the latest Global Competitiveness Report (GCR) of the World Economic Forum by Schwab, Sala-i-Martin & Greenhill [9] is used. The GCR defines three different stages of economies. These are: factor-driven economy (stage one), efficiency-driven economy (stage two), and innovation-driven economy (stage three). Countries that are situated in between these stages are called transition countries, either in transition from stage one to stage two or from stage two to stage three.

According to the GCR (Schwab, Sala-i-Martin & Greenhill), factor-driven economies mainly rely on their facilities and basic competencies which mostly are "unskilled labor and natural resources" [9]. Primarily, simple products and commodities are traded. Workers have very low incomes. The differentiation of the individual companies mainly happens through pricing. Furthermore Schwab, Sala-i-Martin and Greenhill explain that, economic advancement is achieved through "well-functioning public and private institutions […], well-developed infrastructure […], a stable macro-economic framework […], and a healthy workforce that has received at least basic education […]" [9].

Especially emerging and developing countries, usually located in the GCR at stage one and in transition to stage two, can benefit from a comparison to countries with the same status since this avoids both the desperate pursuit of overambitious aims towards industrialized countries and the rather demotivating comparison with lesser developed countries.

3.8 Scope of intervention

In order to be able to evaluate the quality and the stage of maturity of an innovation system it is important to describe the determinants. The maturity level of an innovation system as well as the performance of its actors may be improved by means of policy measures addressing either individual or groups of determinants. As determinants may often be linked to one another, the potential impact might be augmented. Some determinants may easily be improved whereas others might be much more complex.

Therefore a portfolio analysis is used to compare the required mandatory effort and the potential impact of the determinants which are below average in the analyzed innovation system. One scale represents the "efforts needed" in terms of capability to provide public funds, investments in infrastructure and human resources, policy reluctance, structural changes, etc. The other one represents the "expected impact" in terms of improved framework conditions or improved innovation capacity of the actors. As a result of these findings, specific policy measures addressing these determinants can be formulated.

3.9 The ANIS report

Generally, as outcome the policy makers or other interested parties receive an ANIS report which includes the following items: (1) brief description of the economic situation of the country, (2) analysis of each level of the innovation system of the given country, region or local economy, (3) evaluation of the determinants, (4) defining scope of intervention within the innovation system, (4) benchmarking with other countries, regions or local economies, (5) list of interviewed partners. The reports can be updated periodically in order to discover trends which may be relevant for the adjustment of programmes and other innovation support measures.

4. Case Study: ANIS in Manaus, Brazil

The following chapter summarizes an example of a realized regional analysis. The "Summary Report on the Determinants of the Local Innovation System of Manaus, Brazil" was conducted by the Institute for Innovation and Technology and VDI/VDE-IT in 2010. It was supported by local partners and co-authors. More than 50 policy makers and innovation experts from Manaus contributed. Mr. Guajarino de Araújo Filho was the coordinator of the Brazilian expert team.

The regional analysis focused on those determinants for innovation strategy that needed rather small but adequate efforts to improve with high potential impact – with a short way from conceptualization to implementation.

The final recommendations are intended for policy makers. They prioritize among more and less effective measures. The summary report and the conclusion workshop, held in Manaus, contained a comprehensive description, how to implement the recommendations including the expert opinions from macro, meso and micro level of the local innovation system of Manaus.

The study has been recognized as a pioneering initiative in Brazil. The main recommendation which was derived from the expert opinion surveys and interviews was to improve the „well-being" of entrepreneurs, in particular through:

- Promotion and stimulation of entrepreneurial activities "out of the university" and/or "out of R&D institutions" (Spin-Off programs),
- Integration of an "entrepreneurial culture" in the curricula/programs of all levels of formal education
- Implementation of a broad variety of training programs in entrepreneurship, management skills, innovation management, allow easy access to such programs,
- Promotion of campaigns and prizes to recognize the best business ideas and most successful entrepreneurs (Business Plan and Start-up Competitions).

The following results can be considered as being directly or indirectly connected to the ANIS activities in Manaus:

- Fapeam (Foundation of Support the Research of the State of Amazonas (Manaus)) is starting a process of supporting a Business Plan Contest – the first in the Amazonas State – in which local technology-based start-ups will have their efforts rewarded. With Fucapi's (Analysis, Research and Technology Innovation Center Foundation of Manaus) technical support, the contest has as secondary goals to boost the venture capital culture, and the stimulus to create an angel investors association.
- Fucapi and Sebrae (Brazilian service of assistance to micro and small enterprises) have started a joint initiative named ALI Project, in which junior professionals (called Local Innovation Agents – ALI), supervised by a senior manager, help SMEs to establish and start plans focusing actions on innovation. There is a goal to reach at least 400 SMEs in Manaus, as a part of a nationwide initiative.

5. Conclusion

5.1 Advantages of ANIS

Many countries still face major challenges to improve the productivity and effectiveness of innovation-emerging processes in their knowledge-based societies. Mapping the quality of the individual innovation-supporting environment is an important starting point for target-oriented activities. It needs a common, widely accepted and "easy to use" interactive approach to involve major actors from academia, industry and governments – as a Triple Helix Model – to enhance the linkages between these very different stakeholder groups and, as perspective, enriched economic processes by using the value out of the commercialization of innovations.

The application of the ANIS methodology can lead to direct and immediate contributions to strengthen the NIS, especially in developing countries. The approach requires a very early personal, responsible and direct integration of the most important players from academia, industry and governments. This generates an immediate attention to the subject of innovation culture and the necessary changes in the system. Self-assessment stimulates mutual discussion among the involved parties. The – in most cases – succeeding direct involvement of important stakeholders would hardly be reached by traditional desktop analysis or the evaluation of international studies. In contrast to this, the results of the comprehensive ANIS process provide a good insight view of the national, regional or locally related performance of the innovation system. It shows the best options to enhance the performance and the long term impact.

ANIS is not only an indicator-based analysis tool, but rather a very practical implementation of a forward looking Triple Helix Model. The approach is focused on the main determinants that can influence an innovation system; not as an assessment of “good” or “bad”, but instead as a valuation of maturity of determinants.

It also initiates the developing process of essential strategies for the positioning of academics, industry partners and government responsibilities to improve the subject of innovation as the main driver for economic strength. The option for a joint approach of all necessary parties follows the ideas of the Triple Helix Model. Periodical updates of the analysis may discover trends and options for further improvements of the innovation environment. As such, ANIS is applicable not only to transition and emerging countries but also to industrialized economies.

5.2 ANIS: a starting point for strategy development

The results of an ANIS process could build an ideal starting point for visible changes in the innovation environment. Since the result tables do not only contain the facts out of the interviews and their interpretation but also the clear scope of intervention to improve the innovation system towards a more efficient performance and the benchmarking against comparative portfolios, the policy makers receive a detailed description of their innovation system on which they can base their decision for further policy implementations. Furthermore, the “train-the-trainer” approach which ensures a collaborative work between the ANIS analysts and the on-site experts in the respective country. The long term impact still depends on readiness for implementation of recommendations as all stakeholders must agree to work on new informal and formal mechanisms to enhance the framework to reach welfare out of innovation.

6. Policy implications

Innovation is the successful way to transform ideas into wealth. The achievement of this goal needs a clear commitment and involvement of the stakeholders at all levels of knowledge-based societies. A practical and purposeful pathway towards excellent performance and suitable support mechanisms requires detailed analyses of the existing environment in advance. Policy makers – in all areas of the global landscape – are often not very familiar with the specific toolset to enhance the innovation culture. Opening up a channel for communication of innovation is one of the essential success factors for building the needed capacities and capabilities. Dialogues about the demand within the triple helix of stakeholders should focus on the logical chain to develop the best suitable policy measures. The purposeful journey starts with monitoring and foresight, leads over to policies and strategies, followed by the announcement of programs and their implementation.

The strengthening of national innovation policies is crucial particularly for developing countries. ANIS provides an analytical model, which can be used as a basis for holistic profiles of governments to build or enhance strong national innovation policies with their programmatic approaches that help to accelerate capacity building. In this sense ANIS is an exemplary triple helix approach.

7. Directions for further research

The ANIS toolset is a fairly young approach, designed and carried out initially in different regions of Indonesia and the Middle East (Egypt, Jordan, Syria), in Africa (Libya, Namibia, Zambia, Botswana) and in Manaus, Brazil by the Institute for Innovation and Technology (iit). A team of analysts from the iit and local stakeholders conducted all steps of the analyses.

The ANIS approach is constantly evolving. The development of this approach into a triple helix model could be one of the possible future activities of the ANIS team. For this, the close cooperation with regional experts is important.

As with every analytical tool also ANIS has still some pitfalls of social sciences to overcome. The following table summarizes the five most important pitfalls to reach the general objectives of ANIS and possible solutions for further research:

Table 1. Pitfalls and further research aims of ANIS

General Objective	Pitfall	Solution / Improvement
Mapping the clear status of innovation for a nation or a region	Measuring effectiveness and quality of innovation remains a challenging task	Further research towards a generally accepted "Innovation support impact measurement"
Exploration of interaction between academia, industry and government to enhance innovation culture	Lack of openness, trust and knowledge during interviews or different understanding of the terms 'innovation' or 'system'	Full involvement of main stakeholders with peer group interviews and train-the-trainer approaches
Gap analysis of the innovation environment	Tendency towards social desirability answering	Introducing a model of feedback loops and strategic derivatives
Benchmarking against comparative portfolios	Comparing nations and regions could end up in simple "better or worse" observations	Introduction of ANIS in regional networks, such as the MENA approach by the World Bank [10]
Clear scope of intervention to improve the innovation system with high potential impact	Recommendations are often more a wish-list, without a realistic perspective for implementation	Development of an "Innovation Value Chain" with an included time-resources strategy

In addition, some specializing applications for the ANIS approach are conceivable. ANIS could be used to analyze national innovation systems with regard to specific technology fields or applications. Furthermore, ANIS could combine the results of the national and local analyses, by taking regional circumstances into account and benchmark them with comparable sub-regions. And last but not least, ANIS could provide a resolution of metropolises as independent innovation systems with specific characteristics.

References

[1] iit - Institute for Innovation and Technology, Berlin (2012). "ANIS – Analysis of National Innovation Systems" [online]. Available at: www.iit-berlin.de/sektionen/innovationssysteme-und-cluster-1/anis. Accessed on 25 June 2012.
[2] Belitz, H. et al. (2011). An Indicator for National Systems of Innovation – Methodology and Application to Industrialized Countries. Berlin: DIW, p. 3.
[3] Patel, P., & Pavitt, K. (1995). "Patterns of Technological Activity: Their Measurement and Interpretation." In Handbook of the Economics of Innovation and Technological Change, by Paul Stoneman, 14-51. Oxford: Blackwell.
[4] Nelson, R. (1993). National Innovation Systems: A Comparative Analysis. New York: Oxford University Press.
[5] Lundvall, B.A. (1992). National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning. London: Pinter.
[6] Wolf, E., Zerres, C. & Zerres, M. (2009). Delphi-Technik. London: Bookboon.
[7] iit - Institute for Innovation and Technology (2012). Annual Report 2011 "Innovationen messen: Indikatoren und Methoden". Berlin: iit, p. 36.
[8] iit - Institute for Innovation and Technology (2010). Summary Report on the Determinants of the Local Innovation System of Manaus, Brazil. [online]. Available at: www.iit-berlin.de/sektionen/innovationssysteme-und-cluster-1/anis. Accessed on 25 June 2012, p. 28.
[9] Schwab, K., Sala-i-Martin, X., & Greenhill, R. (2011). The Global Competitiveness Report 2011-2012. Geneva: World Economic Forum, p. 8-11.
[10] The World Bank (2012). Middle East & North Africa (MENA) [online]. Available at: www.worldbank.org/projects. Accessed on 25 June 2012.

DOES ENVIRONMENTAL REGULATION FOSTER THE DIFFUSION OF COLLABORATIVE INNOVATIONS? A STUDY ON ELECTRONICS WASTE REGULATION ON BRAZIL

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Abstract
This paper aims to check the applicability of the sustainable innovation system concept on developing countries, verifying if them are suitable for such an approach, by means of a comparative and investigative study, exploring how environmental regulations related to electronics e-waste mobilize networks of academic, private and government actors for the generation and diffusion of sustainable technical and managerial innovations for compliance with these regulations. A study, based on legislation analysis and a survey of government, academy and companies actions is presented for the case of Brazil.

Keywords: Environmental regulation; collaborative innovation diffusion; electronics waste management technologies.

IDENTIFICATION OF THE SECOND DEATH VALLEY IN INNOVATION PROCESS IN KOREAN ENERGY SECTORS

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Abstracts

In commercializing process of technological innovation, there is a Death Valley, which blocks technological innovation and commercialization (Auerswald & Branscomb, 2003). Public R&D for recovering the Death Valley has been designed in Korean governmental policies. To decrease technological uncertainty, risk, and ambiguity, various R&D policies have supported SMEs in Korea both directly and indirectly. Indirect supports for SMEs have been mainly based on Korean universities' R&D.

This study decomposes the traditional Death Valley into the 1st Death Valley and the 2nd Death Valley. The 1st Death Valley has been studied frequently, and various policy suggestions have been recommended in academic and policy papers (Cooper, R. G., 1990; Jolly, V. K., 1997). However, studies on the 2nd Death Valley are rare. The 2nd Death Valley seems to be located at the firms' middle or latter commercialization process, in which the value of technological innovation seriously drops. This study argues that there can be serious appropriation problems in the 2nd Death Valley; therefore public R&D as well as typical financial aids can support the 2nd Death Valley areas.

This study compares the traditional 1st Death Valley to the 2nd Death Valley. Common and different points, between the two, are identified. Policies adjusted to each Death Valley are suggested. Particularly, the author describes the 1st and the 2nd Death Valley in Korean energy sectors' examples.

Keywords: 1st Death Valley, 2nd Death Valley, public R&D, appropriation, spill-over

Introduction

Incubation stage of technological innovation can be understand as enhancing probability of commercialization in aspects of technological and market point of view (Jolly, 1997).

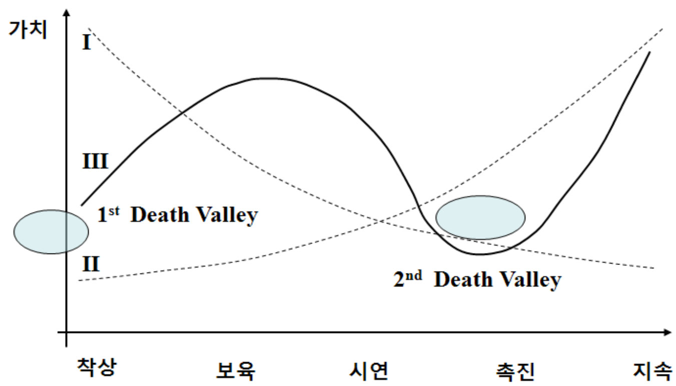
The difficulty to decide whether or not the technological innovation can be commercialized comes from 1) imperfectness of technological principle, 2) technological uncertainty of development path and speed, 3) marketability and its realization period.

It is assumed that Death Valley resides between imaging and incubating. Therefore numerous innovative seeds do not develop/grow into bigger and valuable ideas because of Death Valley. It is necessary to study what kinds of things deter ideas to grow further, and empirical research on Death Valley is required.

Demonstration stage can be understood as technical realization stage of new product or process, and as a stage, which meet consumers' concrete needs (Jolly, 1997). In demonstration stage, product and process should meet the market's needs. It is assumed that the 2nd Death Valley resides in demonstration stage, of which research are almost rare.

The 2nd Death Valley

The concept of W type Death Valley can be imported. The graph can be pictured as follows.



I curve means that as time goes on, the value of innovation continuously decreases. At the starting stage, the ideas seem to be high valued, as time goes on, the value decreases. Particularly, in the process of pilot product development and meeting consumer's needs, the value continuously decreases. II curve get success at all stage of development. It starts from original and valuable ideas and its final product also meet the consumers' request. It is very few and rare. III curve get success until imaging stage, however since demonstration, the value drops, and re-increase, that is W type value curve. It is most typical case.
The 1st Death Valley resides in recovering technological problems and uncertainty, and the 2nd Death Valley resides in meeting market needs. However, in reality, the Death Valleys are overlapping, and the two crises are overlapping. What is mattered is which is more dominant.

W type Death Valley in New & Renewable Energy and Unconventional Energy Development

The United States Department of Energy (DOE) uses the following guidelines throughout the department in conducting Technology Readiness Assessments (TRAs) and developing Technology Maturation Plans (TMPs) (DOE, 2009). Technology readiness level can be decomposed into nine sub-stages. And characteristics of each TRL can be described such as in <Table 1>

<Table 1> Technology Readiness Level (TRL)

Phase	TRL	Contents	DOE's description
Basic	TRL1	Understanding principles	Scientific research begins translation to applied R&D - Lowest level of technology readiness. Scientific research **begins to be translated** into applied research and development. Examples might include paper studies of a technology's basic properties.
	TRL2	Formation of technological concept and identification of applicable field	**Invention begins** - Once basic principles are observed, practical applications can be invented. Applications are speculative and there may be no proof or detailed analysis to support the assumptions. Examples are limited to analytic studies.
Experimental	TRL3	Analysis and experimental studies of main functions and proof of conceptual characteristics	Active R&D is initiated - Active research and development is initiated. This includes analytical studies and laboratory studies to physically validate analytical predictions of separate elements of the technology. Examples include **components** that are not yet integrated or representative.
	TRL4	Proof of constructs and characteristics at laboratory level	Basic technological components are **integrated** - Basic technological components are integrated to establish that the pieces will work together.
Trial products	TRL5	Proof of functions at **similar operational**	Fidelity of breadboard technology improves significantly - The basic technological components are

		level	integrated with reasonably realistic supporting elements so it can be tested in a **simulated environment**. Examples include "high fidelity" laboratory integration of components.
	TRL6	Demonstration of system and sub-system at similar operational level and production of trial manufactured goods	Model/prototype is tested in relevant environment - Representative model or prototype system, which is well beyond that of TRL 5, is tested in a relevant environment. Represents a major step up in a technology's demonstrated readiness. Examples include testing a prototype in a high-fidelity laboratory environment or in **simulated operational environment**.
Product development	TRL7	Demonstration of system and trial manufactured goods at operational level	Prototype near or at planned operational system - Represents a major step up from TRL 6, requiring **demonstration of an actual system prototype** in an **operational environment**.
	TRL8	Completion of system and technical test	Technology is proven to work - Actual technology completed and qualified through test and demonstration.
Commercialization	TRL9	Operational test of system	Actual application of technology is in its final form - Technology proven through successful operations.

Also, the author can match the strong pole with each TRL, which means what plays an important role in each TRL. From TRL 1 to TRL 3, generally universities play major roles in Korea. For basic research is important in those stages. From TRL 4 to TRL 5, government sponsored research institutes (GRIs) play important roles in Korea. GRIs do bridging roles between universities and industries through stage of TRL 4, 5. And firms are in dominant position from TRL 6 to TRL 9. There can be sectoral differences, whether the field is IT (information technology), BT (bio technology) or GT (green technology).

<Table 2> Traditional role of Triple Helix in each TRL

Phase	TRL	Contents	Change of Triple Helix Relationship
Basic	TRL1	Understanding principles	University
	TRL2	Formation of technological concept and identification of applicable field	**University**
Experimental	TRL3	Analysis and experimental studies of main functions and proof of conceptual characteristics	**University**
	TRL4	Proof of constructs and characteristics at laboratory level	**University and GRI (government sponsored research institute)**
Trial products	TRL5	Proof of functions at **similar operational level**	**GRI**
	TRL6	Demonstration of system and sub-system at similar operational level and production of trial manufactured goods	Firms
Product development	TRL7	Demonstration of system and trial manufactured goods at operational level	Firms
	TRL8	Completion of system and technical test	Firms
Commercialization	TRL9	Operational test of system	Firms

However, as evolution of triple helix goes further, significant role change is happening contingent on technological sectors. For example, the author can describe evolution of triple helix in each TRL like <Table 3>. This paper will deal with further relationship between TRL and evolution of triple helix in consideration of sectoral differences in Korea.

<Table 3> Evolution of Triple Helix in each TRL

Phase	TRL	Information Technology	Bio Technology	Green Technology
Basic	TRL1		Firms doing basic research	University
	TRL2		Firms doing basic research	
Experimental	TRL3		Firms doing basic research	
	TRL4		Firms doing basic research	
Trial products	TRL5	Entrepreneurial universities		
	TRL6	Entrepreneurial universities		
Product development	TRL7	Entrepreneurial universities		Firms
	TRL8	Entrepreneurial universities and firms		Firms
Commercialization	TRL9	Entrepreneurial universities and firms		Firms

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References

Auerswald, P. E. & L. M. Branscomb, 2003. "Valleys of Death and Darwinian Seas: Financing the Invention to Innovation Transition in the United States", *The Journal of Technology Transfer*, Vol. 28, Nos. 3-4, 227-239.

Cooper, R. G. (1990), New Products: What distinguishes the winners?, *Research Technology Management* 6 (27).

Jolly, V. K. (1997), Commercializing New Technologies, Harvard Business School Press, Boston, MA.
"Technology Readiness Assessment Guide (DOE G 413.3-4)", United States Department of Energy, Office of Management. October 12, 2009.
https://www.directives.doe.gov/directives/archive-directives/413.3-EGuide-04

Development of a technology readiness assessment measure: The cloverleaf model of technology transfer [PDF] (▪ ▪ : uncw.edu) LA Heslop, E McGregor… - The Journal of Technology Transfer, 2001 – Springer.

TOWARDS ENDOGENOUS DEVELOPMENT IN INDONESIA: AN INSIGHT OF UNIVERSITY – INDUSTRY – GOVERNMENT COLLABORATION IN INNOVATION FOR DEVELOPMENT

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Abstract
The collaboration of university – industry – and government, or widely known as the triple helix approach, is an ideal strategy to spark development through science and technology innovation required for developing countries such as Indonesia. Over the past 40 years, Indonesia has, on ad-hoc basis, implemented the triple helix approach to support its technology based projects in several industrial sectors with considerable success. Notable examples include the launch of Palapa telecommunication satellite, the development of Bontang city in East Kalimantan, and the design and production of armored personnel carrier for the Indonesian military industry. Indonesian leading technological university, Institut Teknologi Bandung, has played a major role as an incubator for the country's technology based start-up companies that were involved in some of these projects, and it also provided crucial input for the science and technology innovation that led to the projects' success. Despite this achievement, Indonesia still does not have a grand design for innovation that is needed to support its development. Indonesia needs to establish a robust innovation system that institutionalize the triple helix approach with university leading the development as its core strategy. This paper is an insight of an individual who has circulated within the three spheres of triple helix as professional and entrepreneur, academic, and government advisor. The paper highlights Indonesia's challenges in the triple helix implementation encountered by key sectors (i.e. government, and the university). It recommends: 1) University-led development in the triple helix implementation to support innovation and development. This can be achieved through reformation of science and technology education, and the establishment of active and engaging research centers in universities. 2) An establishment of national-regional innovation system that has strong mandate to coordinate and support science and technology innovation among all key stakeholders, which incorporates triple helix approach, and integrated into national development strategy. A brief example of Chinese experience in its national innovation system is also provided for reference and consideration.

Keyword: Incubator, Institutionalize, Developing countries, Science and technology innovation, Technology based start-up company, Triple helix, University-led development

G. Advancing Theories in Triple Helix Model

GOVERNANCE OF TRIPLE HELIX RELATIONSHIPS: PRINCIPLES OF INTERMEDIATION, OR WHO IS IN CONTROL WHEN THE STATE, THE UNIVERSITY AND THE INDUSTRY INTERACT?

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Abstract
Current issues of sustainability and economic growth and the need to stimulate innovation have exposed the lack of scientific knowledge within the governance literature that can support and justify government involvement. Corporate governance theory addresses issues of financing and control of private production assets, but does not relate these to the challenges of governance of innovation. The emergent literature on Triple Helix interactions, on the other hand, has generated multi-layered accounts and cases of dyadic and multilateral relationships between the state, the university and the industry, and channels for knowledge and technology transfer between public and private sector research establishments. At the same time, none of these knowledge fields has addressed the fact that governance involves multi-layered intermediation practices. This paper introduces the concept of intermediation and its role in the governance of innovation and Government intervention with the economy at regional and national level. In this work we synthesise the research expertise accumulated at the Research Centre on Business Clusters, Networks and Economic Development (BCNED - http://www.surrey.ac.uk/bcned), and we present four cases of intermediary organisations that assist the UK Government in stimulating innovation in the health technology sector. We compare and contrast different modes of financing R&D in the health technology sector in the UK, and we highlight the role of intermediary organisations for the two-way communication between government and industry and their effect on channels of knowledge and technology transfer across the university and the industry.

Keywords: intermediation theory, Triple Helix interactions, governance of innovation, changing role of the state

Introduction: Challenges to Governance of Innovation

The literature on sustainable growth and development of knowledge-base economy has recognised the critical role of university links and active transfer of knowledge and technology. Innovation takes place both in the public (university) and in the private (industry) sectors. The competitiveness and performance of firms is increasingly dependent on successful R&D collaboration with universities and on sharing knowledge and technology outputs, or absorbing and commercialising knowledge and technology, generated by public sector research establishments. A new knowledge-based economy results from the evolution in the university-industrygovernment relationships, where knowledge is the main pillar for the success of the economy itself and contributes to the development of new technologies disseminated through commercial enterprises. These new trilateral relationships are represented by a model defined as Triple Helix, which is characterized by complexity of interactions and interdependencies between actors and a high flow of knowledge from one actor (university) to the other (industry), and vice versa, called Knowledge and Technology Transfer (KTT).

The KTT process raises significant governance questions and is increasingly associated with intermediation and facilitation by a variety of organisational establishments. The intermediaries emerge to facilitate communication between different parties, or to translate messages from one economic actor to another, and to facilitate partner searching and matching as well as negotiations across the public and the private sphere of the innovation process. Examples of such intermediaries are law firms, facilitating in contract agreements, consultants, assisting public and private sector organisations (and the Government itself) in procurement, financing, and assessment of innovation capabilities of firms, universities, or other organisations. Finally, intermediaries are various service firms, including business and legal services, accounting and management, or communication and representation services. Service outsourcing from the public and the private sector has created a large pool of intermediaries that are actively delivering intermediation and facilitation services, and yet, the literature on intermediation is extremely scarce.

This paper aims to review the literature on intermediation and governance at the intersection between the public and the private sector and the literature on the triple helix model and the role of government. We present a theoretical model that incorporates intermediation into the dynamics of Triple Helix interactions and offers a framework for the analysis of the boundaries of governance, coordination and control.

Corporate Governance, Public Governance and the Role of Government

The literature on governance comes from two streams of thought – corporate governance and public administration and regulation theory. There have not been many attempts to integrate these two streams. The discussion on corporate governance has been driven by scholarship research that focuses attention on the Anglo-American corporate system based on publicly traded assets, distributed ownership, separation of ownership from control at corporate level, and the distribution of rents among investors and other residual claimants. The discussion has been dominated by concerns with the effectiveness of the Boards of Directors that represent shareholders' interests, and exercise a monitoring and control function against the opportunistic behaviour of managers (Todeva, 2005)

Corporate governance in this literature refers to: a process of supervision and control over company management; economic agents giving overall direction to firms; the sum of control and co-ordination activities that compose of the internal regulation of business in compliance with external obligations; the system by which companies are directed and controlled; the system of external and internal checks and balances that ensures companies discharge their accountability to shareholders and stakeholders (Tricker, 1984, The Cadbury Report, 1992, Cannon, 1994, Parkinson, 1994, Solomon, *et.al.,* 2004). There are more integrated definitions that describe corporate governance as a system / mechanism for allocation of capital and corporate resources and for coordination and control of economic activities at firm level that facilitates strategic direction, accountability, transparency and wealth creation (Todeva, 2005).

The *corporate governance* literature has focused of structures that substitute oR compensate for the inefficiencies that emerge from the separation between the ownership and control of assets, and the agency costs associated with this. Hill & Jones (1992) summarise three sources of agency costs from the perspective of agency theory: a) principal's monitoring expenditure (including the design and management of corporate governance system, appointment and running of Board of Directors, and all types of shareholder activism); b) agents' bonding expenditure (managing the intra-corporate accounting process, plus all risks of managing relationships with the other stakeholders); and c) residual loss (supplementing for risks, taken beyond the home market, or beyond the home corporate governance system and contract enforcement practices. Contract enforcement is seen as the remedy to all agency problems. Exit strategies by customers, suppliers, employees, or indeed investors are discussed as sanctions that complement contract enforcement.

This literature ignores two major issues. These are first, that corporate governance involves coordination and control not only of resources (assets and capital), but also of relationships and production activities. Second, governance involves facilitation of relationships and activities, and not merely control. Fligstein and Freeland (1995) stylise from the literature a number of internal control problems and external control issues that are associated with coordination and control of relationships: 1) the control relationships between management and workers; 2) relationships between management and shareholders; 3) division of labour and the subsequent division of power and responsibilities within the corporation or intra-corporate intra-management relationships; 4) relationships with investors and capital markets; 5) relationships with suppliers; 6) relationships with competitors; 7) relationships with the state, with governments and other public institutions. If we look at the corporate governance as a mechanism for allocation of resources in the corporation and the economy and as a mechanism for wealth creation and generation of value-added, then we need to consider all relations between economic agents that are critical in determining productivity and efficiency. Facilitation and coordination across these relationships is critical.

Regulation theory, on the other hand, promotes the idea that regulation of a socio-economic system requires a legitimate government that has authority and power, as well as the capacity and capabilities, to generate the rules that govern economic behaviour within the system of their jurisdiction. Regulation via rules and laws is seen as an effective coordination of behaviour of economic actors. The rules and the laws are facilitating mechanisms enabling governments to distribute incentives and sanctions across the entire system of economic actors.

There is a shared view among many theoretical perspectives that public administration is simultaneously: a) governance of the society and economy within national boundaries; b) management of the resource allocation process; and c) institutionalisation of justice in the public domain, where public administrators are seen as agents carrying out the public interest with their authority (Wamsley, 1990, pp. 21-29). The leading public administration theories that aim to explain the functioning of public organisations, and the relationships that emerge in relation to the definition and fulfilment of public interests, are: the *public choice theory*; the *social contract theory*; and the *principle-agent theory* (Todeva, 2010).

The *public choice theory* infers that the public chooses the type of the system of governance and mode of regulation through voting the agents that can deliver such system and hence granting power to these agents while in government. The theory advances the discussion on innovation support vs. bureaucratic authoritative allocation of resources, where it is assumed that bureaucratic government is based on hierarchy and command in regulation and decision making, while the innovation in government implies experimentation and the working of a 'free market' (Russell and Waste, 1998; McNutt, 2002; Mueller, 2003). Changing government during elections is seen as bringing innovation in the governance process, rather then as bringing populism and short-termism in the coordination and control of resources, relationships and activities in the economy and society.

The *social contract theory* reflects on the agreement between the public and the government as enacted through democratic elections. Government efficiency in fulfilment of the social contract is measured in terms of democratic accountability (Wilson, 1987). Again, contract enforcement is executed via democratic elections, but there is a substitution in the theory between effective contract enforcement practice and effective and efficient governance of the economy and society.

Principle-agent theory is an extension to the behaviourism in public administration and advocates that the government is composed of elected officials as 'principles', and appointed administrators as 'agents'. Issues of accountability, communications and interactions between 'principles' and 'agents', as well as the role of political incentives and information asymmetries in decision making, are discussed within this theoretical perspective. Researchers are convinced that the policy choices of the 'principles' are 'framed' by the information provided by appointed and entrusted administrators (acting as agents), alongside with the bureaucratic discretion of the latter (Hill, 1985; Bendor, 1990; Selden, et. al., 1999). Authors conclude that change of policy direction by the 'principles' is constrained by the monitoring and control costs, associated with a particular structure of principle-agent relationships. The real representation of public interests appears to be driven by the bureaucratic 'agents', rather than by the democratically elected 'principles' in government. The concept of agents is the first recognition that the execution of governance requires certain level of intermediation.

While regulation implies intervention activities at system level, governance, implies intervention at the level of individual economic actors. Governance involves design and implementation of incentives and constraints in order to manage the motives and strategic behaviour of actors. Economic governance is a system/mechanism for allocation of resources, control and co-ordination of economic activities at firm level that facilitates strategic direction, accountability, transparency and wealth creation (Todeva, 2005). The effectiveness of governance depends on solving the agency problem or the problem of intermediation in control and depends on clear allocation of rights to individual agents clear rules establishing rights and responsibilities, and rewards for compliance with these rules.

According to Frances *et.al.* (1991) co-ordination implies the bringing into a relationship of otherwise disparate activities or events. Co-ordination therefore aims at making compatible the efforts of actors that are involved in competitive or co-operative economic activities. Leading questions are *who decides* on the rules and regulations that establish the co-ordination mechanism, *how* this mechanism is *implemented* in a society, *what range of activities* are externally co-ordinated, and which activities are left under *self-co-ordination,* or who are the coordinating agents and the capabilities they require in order to execute effective coordination (Todeva, 2010).

Here we would like to distinguish between external co-ordination, which implies agency, power, and politics, vs. self-co-ordination, which is an expression of the free choices of economic actors, and is interpreted as a spontaneously emergent agreements, compliance practices, or rules and principles that facilitate impartial economic transactions between autonomous and free economic actors. Economic actors in self-coordination enact self-constraints based on their relationships, values, and mutual agreements. The two forms of external governance and internal self-coordination may be congruent within a socio-economic system when one is an extension of the other (Todeva, 2010).

Overall, there are many possible scenarios of coordination mechanisms in the literature - markets, hierarchies (bureaucratic co-ordination), networks, community (ethical co-ordination), self-governing coordination, family co-ordination, political coordination, or any combination between them (Levacic, 1991; Todeva, 1998; Todeva, 2010). These mechanisms evolve during the phase of their implementation and practice, and their design is not the ultimate end of the policy and governance process, as they are 'means-to-an-end', where the end is represented by political objectives. Each mechanism implies a different logic of co-ordination and leads to a variety of outcomes and costs. Each mechanism can be implemented by variety of rules and practices, which can lead to different sets of incentives and constraints, and hence, limiting the actors in their free choices (Todeva, 1998). The governance of innovation hence can employ multiple mechanisms for allocation of resources and coordination and facilitation of behaviour of innovation actors.

Financing Innovation and the Role of Government and Industry

Most of the literature on governance, regulation and public administration refers to coordination of incentives and constraints in the private, commercial sector, or the industry. There is little of this theoretical contribution that is applicable to the governance of the public sector, such as the universities, the health care and social care systems, or the so-called 'public-private-partnerships' (PPPs), all of which require finance by the government. Universities need finance to carry out their mission for knowledge creation and knowledge dissemination, to lead students towards academic progression and development, to develop new research ideas and technologies, to provide knowledge solutions to industry and society as a whole, and to increase the knowledge transfer and collaboration with public and private sector organisations. Industries, on the other hand, need financial support for risky R&D and for innovation that is directed towards serving public needs, as well as to interact and collaborate with universities, or to invest in exploitation of fundamental and basic research. Models of financing innovation focus on the balance between the public and the private sector contributions, as well as the allocation and the direction of R&D in the universities and industry.

Previous work has identified four potential sources of financing R&D: The *government*, which has multiple motivations (knowledge benefits, wealth creation, national development, etc.); Independent *foundations* and charity organisations that receive funds from private citizens, from the government, or from industries; *Banks*, which offer loans and credits for R&D activities; *Venture capital organisation* (VCs), which provide funding for new firms such as spin-offs from universities or large corporations (Kolfsten et al., 1999). It is widely recognised that these alternative funding agents have preferences in their financial practices.

Most of the *basic* or *fundamental research* is essentially undertaken in universities and public sector laboratories and is financed by the government or by foundations, given that it has low market potential and requires risk-free money. The goals and incentives of government and foundations are equally aligned, as they are not for profit organizations aiming at carrying out activities for public benefit. *Applied research* is undertaken both in universities and public sector laboratories as well as in private sector establishments, and it is predominantly financed by foundations, specialised charity organisations and the government, where all actors are sharing the risks. Banks and VCs are very unlikely to invest money in applied research in universities and other research institution, as they tend to be risk-averse. Experimental and developmental research is carried outmainly in private sector laboratories and is financed particularly by banks and VCs organisations with a significant contribution from government (Rebecca Henderson, MIT, 2002).

The role of government has been acknowledged no only in relation to financing innovation and R&D in the public and the private sector, but also in the areas of policies, support infrastructure, and facilitation for the diffusion of innovation. The innovation policies of government are broadly divided into *infrastructural policies*, *diffusion and technology transfer policies*, *mission policies***,** and developing *technological districts and clusters*. The *infrastructural policies* have played a central role throughout the history of the debates on 'National Innovation Systems' (NIS) and the role of Government. In addition to direct investment in technical infrastructure for universities, Justman and Teubal (1996) have described the role of government in the technological development process through its role in building technological capabilities in the university sector and making them available for a variety of applications by companies or other public institutions. In the more advanced countries, this has led to the creation of a wide structure of education services and technological services at the interface of three types of protagonists: the producers of innovation (universities and research laboratories); the collective users of innovation (economic organizations, chambers of commerce, industrial associations); and the autonomous institutions created specifically for dealing with technological transfer (agencies, information centres, incubators).

The *diffusion and technology transfer policies* are the most traditional initiatives by governments. They have been based initially on grants (through subsidies or tax credits) for the purchase of new machinery or equipment incorporating innovations. Throughout the 1980s the emphasis was shifted on measures aimed at favouring the transfer of knowledge with particular attention to small firms. Dodgson and Bessant (1996) point out that these policies may be of little use, if the capability gap that often prevents the smaller companies from making use of external know-how is not filled. For this reason the most recent objectives of these policies have become to promote research within the universities and the small firms; the collaboration between companies and between companies and universities, and the creation of new technology-base firms.

Mission policies consist of setting priority targets and offering financial support for research (grants and funds) into cutting edge technologies, whether carried out by research institutes or firms. The principal objectives of these initiatives are to concentrate State financial resources on both fundamental research and on applied research at a pre-competitive level.

A recent line of support has focused on the development of *technological districts and clusters*. The main target for these initiatives have been technology-based SMEs, where government finances co-location, networking and explicit R&D activities. The formation of regional clusters and networks between private and public bodies, firms and universities, has been the main way to stimulate innovation in SMEs and to extend the dissemination of R&D outputs (Antonelli, 1999).

All four government policies require financial support for their implementation. However, their implementation goes beyond the allocation of resources for innovation. The implementation of innovation policies requires vast facilitation, collaboration and coordination, demanding the involvement of a wide variety of intermediary actors that assist in this implementation process. In addition to finance, the governance of innovation, requires facilitation and intermediation of the knowledge-creation, and the knowledge-transfer, diffusion and commercialisation. Managing complex knowledge-based relationships between the university sector and the industry has been critical both for the rate of innovation, and for the scale and scope of diffusion and transfer of knowledge and technology across public and private spaces. The literature on innovation and KTT explicitly focuses on the motivations of actors and their absorptive capacity to translate and acquire tacit knowledge. Institutional intermediation is seen as the main support mechanism in the KTT process.

The innovation process itself is very diverse with multiple heterogeneous steps. Throughout the innovation process, individual steps have different requirements of time and resources that cannot be fully met by individual firms. Between the beginning of innovation (a product research) and the end of it (a product commercialization) the long process requires multiple competences at the level of basic and fundamental research, through applied research, through concept testing, and then through product testing and market testing.

This process goes beyond the university sector or the commercial sector by themselves, requiring various forms of collaboration and resource and activities links. Different policies are suitable for different stages and different actors, so there could not be any prescriptive rules and regulations on managing such process. The role of government hence, is evolving and encompasses un-prescribed roles of executing all four types of intervention described above. Such dynamic and complex regulatory presence is described in the current thinking of Triple Helix interactions, or co-evolving behaviour of the industry-university-government actors.

Triple Helix Theory and the Role of University, Government and Industry Interactions

In the Triple Helix model, the main domains of the knowledge-based economy have been defined as university, industry, and government (Etzkowitz & Leyedesdorff, 1995). The model is represented by an expanding network system of interactive spirals generated by the university, industry, and government interactions that promote economic development and innovation in the economy. The mission of economic development is increasingly associated with the reproduction of the knowledge base and the systematic production of scientific novelty (Etzkowitz and Leydesdorff, 1995), as well as with the knowledge flows and the transfer of knowledge and technology in the system. In the context of the Triple Helix constellation, the universities adopt a new and third entrepreneurial role that transcends from the previous academic mission of education and research. This role requires an active participation not only in the innovation and KTT process, but also in the associated with these market process and political process, whereby successful commercialisation of university technologies is seen as governments and public institutions meeting their political objectives and performance targets.

The Triple Helix model was developed to reflect on the complex university, industry, and government relations and to offers a new organizational paradigm for the analysis of innovation and new business formation and the expansion of the role of knowledge in society and of the role of universities in the economy (Lissenburgh and Harding, 2000). The triple Helix model induces a new role of government for the creation of new boundary spanning mechanisms, that facilitate academic-industry relations and bridge across the public and the private domains. Such boundary spanning mechanisms facilitate interactions between reflexive and academic sciences and commercial technology, where university and industry begin to be in a continuing flux, assuming tasks that before were largely the province of the other side and with ever increasing quantity and quality of the knowledge exchanged and interactions.

While the whole knowledge-based system of developed market economies can itself be considered as an outcome of interaction among different social elements (market, knowledge production, and public/private governance), the Triple Helix model of university-industry-government relationships provides a heuristic model for studying these complex dynamics. We use the Triple Helix model as a foundation for our discussion of intermediation and the its representation in Fig. 1. This interpretation of the Triple Helix model is co-aligned with previous work on the knowledge-based economy, and the three essential components of geography, economy and knowledge, whose interface creates wealth and economic growth. The interactions between these dimensions generates knowledge infrastructure that supports innovation, which supports sustainable growth in the political economy (Leydesdorff, 2006).

The Triple Helix model brings dynamics and complexity into previous innovation models, such as the 19th century idea of linear relationships between the academia and the industry, or the later *'statistic' model* of the government embraces academia and industry with its regulatory role, directly managing the relations between the knowledge and the commercial sector. The Triple Helix model differs also from the *'laissez-faire' model*, where the university-industry-government relations consists of separate institutional spheres with strong borders and highly distant relations (MacLane, 1996; Leydesdorff and Etzkowitz, 1998).

The Triple Helix model focuses on the knowledge infrastructure of overlapping institutional spheres, with each institution taking the role of the other and with hybrid organizations emerging at the interface. Thus, universities start to hold roles which previously were strictly tied to business (such as new entrepreneurial tasks, marketing, company spin-offs, licenses, and registration of patents), while firms move closer to universities, developing an academic dimension, sharing knowledge, engaging in collaborative projects with universities, involving managers in university's activities, and co-training university's graduates or employees at higher practical skill levels inside their businesses. Finally, government is more and more engaged in universities and business activities, with the aim of facilitating their success.

The literature on the Triple Helix model has contributed to the development of an heuristic model that explains the emerging structure of governance for a new mode of production and diffusion of scientific knowledge. Among the main advantages of this model are the following:

- The arrangements between industry and government no longer need to be conceptualized as exclusively between national governments and specific industrial sectors. Strategic alliance can cut across traditional sectors and countries (Frenken, 2000).
- The driving force of the interactions can be identifies with the expectation of benefit / or profit, which can have several meaning: knowledge, money, employment and economic growth (Leydesdorff and Van Besselaar, 1998).
- The foundation of the model in terms of expectations gives a strong idea of uncertainties and the role of chance in the iteration of links between actors (Bruckner et al., 1994).
- The expansion and improvement of the higher education sector have provided society with a realm in which different representations of sustainability can be entertained, whereby optimisation of profits and benefits across the system and continuous improvement are required (Etzkowitz and Leydesdorff, 1995).
- The tensions in relationships between university-industry-and government need not to be resolved, given that the source of life is in the perturbations and interactions among actors (Etzkowitz and Leydesdorff, 1995).
- The helices communicate recursively over time in terms of each other's own code, where economic expectations (such as profit, growth) and scientific expectations (such as knowledge and publications) have to be related and have to convert into one another. Moreover, they can also take the role of each other, to a certain extent (Cowan and Foray, 1997).
- The model is consistent with the neo-institutional model of stakeholder arrangements and can be used as a methodological framework for case study analysis. Given the new mode of knowledge production, case studies can be enriched by raising the relevance of the three major dimensions of the model and various sub dynamics stemming from their interactions.
- The model also can be informed by the increasing understanding of complex dynamics and can be utilised by simulation studies, or by evolutionary economics (e.g., Malerba *et al.*, 1999; Windrum, 1999).
- The model is represented as a meta-biological model and induces evolutionary thinking to the economic and sociological notions of governance, innovation, interaction, facilitation and the transfer of knowledge among different institutional agents (Luhmann, 1984; Leydesdorff, 2001).

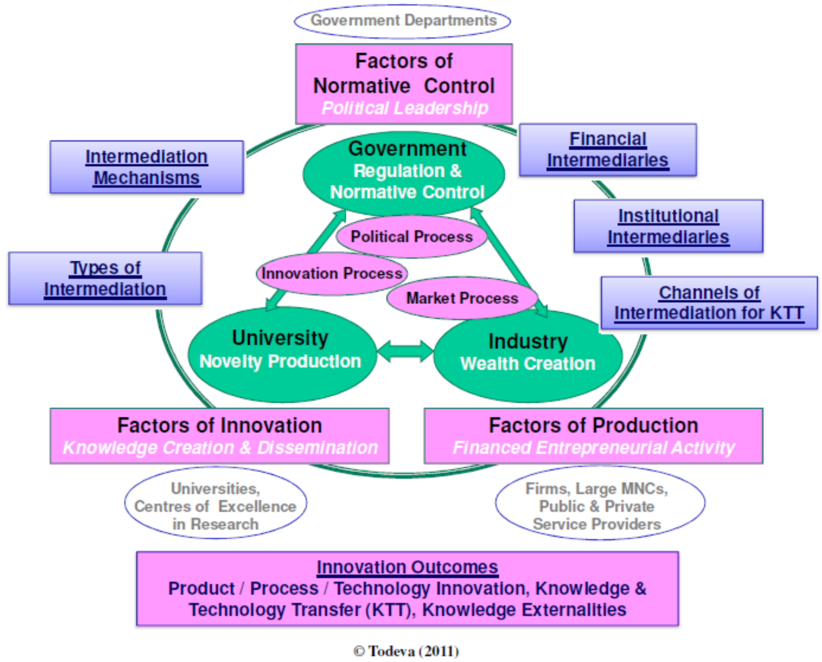

Fig. 1. Intermediation of Triple Helix relationships

In our extension to the Triple Helix model, we have put emphasis on four additional aspects. *First*, this is the fact that the dynamics in the Triple Helix interactions stems from even deeper interaction and overlap between the market process of competition and competitiveness, the political process of priority setting, defining missions and political objectives, or allocation of resources, and the innovation process of invention, creativity and exploitation of new knowledge and technology (indicated on Fig. 1. by the small spheres inside the Triple Helix). The outcomes from the simultaneous enactment of these processes result in complex motivations and complex behavioural orientations of all actors. *Second*, this is the interpretation of the three helixes in terms of factors of production (industry), factors of innovation (university), and factors of normative control and regulatory activity (government). Economic grow and sustainable development requires utilisation of all three factors, where factors of production change under the influence of factors of innovation, factors of innovation are enabled by factors of production, factors of normative control are employed for the management of both factors of innovation and factors of production, while the latter underpin the very existence of government. *Third*, the dynamics of the Triple Helix generate innovation outcomes (product and process innovation, or knowledge and technology transfer), which further feeds into subsequent cycles of change and interaction across the Helix. Finally, the *fourth* extension to the Triple Helix model, is the role of intermediaries, or these agents that help university-industry-and government to perform their role, and translate the message from one helix to another, while helping them to engage in direct knowledge and technology transfer, or to finance the interim steps of it. Overall the model induces assertions about complex and indirect influences between multiple agents representing heterogeneous types of institutional formations, which require multi-layered facilitation and intermediation for their interactions.

Intermediation, Facilitation and Accountability

Intermediaries are actors that place themselves in the middle of relationships between other actors (i.e. university-industry-government) and facilitate the whole process of interaction. Historically, intermediaries, such as wholesalers, retailers and financial institutions have emerged because they reduced search and other transaction costs for sellers and buyers. Intermediated markets, where intermediaries purchase products from sellers and sell them to buyers have demonstrated higher efficiencies, compared with and search markets, where sellers and buyers meet and negotiate directly (Gehrig, 1993). Although intermediaries charge a fee for their services, they can reduce the transaction costs associated with search and bargaining. Several other aspects of intermediation are also discussed in literature. For example, Garella (1980) emphasizes the role of a middleman in mitigating market failures caused by asymmetric information. Rubinstein and Wolinsky (1987) analyse the function of intermediaries, using a search–theoretic model, where intermediaries are viable when they increase the chances of a seller finding a customer. Agrawal (2001) specifies the meaning of search and bargaining costs as the time and other resources necessary to search for potential collaboration partners and the costs associated with the negotiation and the coordination with potential partners, where it is often necessary to deal with asymmetric information and other transaction costs related to motivation and incentive problems with regard to each of the collaborating agents. In other words, intermediaries are entities that facilitate the university-industry links (UILs), reducing the individual search and bargaining costs for each collaboration partner, creating opportunities for meeting potential partners, and directly coordinating joint research projects or other collaborative activities through management and consultation. Intermediaries, such as banks, also are engaged in financing activities, which contributes directly to the integration of factors of production of innovation, and of normative control and the mitigation of risk and uncertainty about future results from the joint projects.

Intermediaries may initiate relationships and facilitate the creation of links between a university and a company. They may finance the KTT channels and they promote the innovation that emerges from this interaction. Intermediaries are vital to reach for possible partners and to offer a third-party evaluation of their capabilities or the potential synergies. Varios classifications of intermediaries refer to a number of types: 1) *institutional intermediaries* are public agencies that offer finance and incentives to encourage knowledge transfer; they offer also a variety of services in order to facilitate interaction among researchers and firms, to stimulate new market entries by leveraging IP from universities, and to promote the circulation of tacit knowledge by placing university graduates in SMEs; 2) *general purpose intermediaries,* such as legal firms that facilitate patent protection and licensing, or other private sector consulting organisations that specialise in evaluation, research and intermediation; 3) *specialized intermediaries,* such as the university Technology Licensing Office (TLO) or Technology Transfer Office (TTO), that seeks out internal innovations, and helps to codify research outputs via patenting, and licence agreements to commercial users; 4) *financial intermediaries*, such as, Venture Capital organisations (VCs) or Business Angels that supply risk capital to commercial establishments that employ research active staff (Yusuf, 2008). Frequently, such a provider brings additional tacit knowledge in the form of managerial know-how, contacts, troubleshooting skills or risk assessment skills, which can assist start-ups (Hellman and Puri, 2002).

All of these types of intermediaries differ substantially from one another in terms of facilitation initiatives, knowledge and technology transfer channels, purposes, activities, and the kind of knowledge they facilitate (tacit or codified). The differences between intermediaries relate to three issues: the type of activities, type of channels for knowledge transfer, and the type of knowledge. There are several channels through which knowledge and technology are exchanged between partners and each channel requires different type of intermediation. The main channels described in the literature through which knowledge is transferred from one partner to another are: patents, licensing, collaborative and contract research, scientific publications, consultancy, co-operation in graduate education, and the creation of spin-off companies from the university sector.

Patents enable a firm to exploits invention developed by academic researchers, or by a commercial firm. The commercial outcomes from this innovation are expropriated by a particular actor. Patenting scientific discoveries assist scientists to push their discoveries to the business sector. The business sector, however, has to come across this information, which requires additional resources for search and evaluation. Among the effects of university patents are: a major source of income for the university and growth of the stock of knowledge that can be used in future education programs (Jensen and Thursby, 2004). *Licensing* enables the use of a technology or a new process by a company. Licensing has been traditionally the most popular way of university technology transfer and involves limited transfer of tacit knowledge (Siegel et al., 2003). There are two main outcomes from licensing: the growth of new knowledge - stored and available for future research projects, and a source of income from royalties (Thursby et al., 2005). Authors argue that patenting and licensing are not the main channels of university-industry knowledge transfer and contribute for a small proportion of public-private interactions if compared with other formal arrangements such as contract research and joint research agreements (Roessner, 1993; Schartinger et al., 2001; Agrawal and Henderson, 2002; Levy et al., 2009).

Collaborative research involves design and conducting R&D projects jointly by industries and university/science institutions, either on a bi-lateral basis or on a consortium basis. Most benefits for industries from interaction with universities come from formal research collaboration rather than from knowledge exchange (Earlier Swann, 2002; Monjon and Waelbroeck, 2003). According to the literature, collaborative research is the most widespread form of knowledge transfer, and this has a strong positive effect on industry performance (Zucker et al., 1998; Meyer-Krahmer and Schomoch, 1998). *Consultancy & contract research* represent research commissioned by industry, and refer to scientists' interactions with the private sector which include funding and sponsorship, institutional affiliations, tenure status, support of students, reputation or other scientific values. The combination of in-house research, networking with industry and capacity to organize conferences and meetings, enables the university to bring together entrepreneurs and professionals for face to face encounters that can forge university-industry links

enabling partners to gain contacts and innovation ideas (Bramwell and Wolfe, 2008). Schartinger et al. (2002) observed also that collaborative and contract research are used by industry in an opposite way - when an firm uses more of one form, it tends to use less the other form.
Scientific publications are a method for knowledge transfer used both by researchers from the academia and from the industry. Industries consider codified output, such as publications, as the most important channels to transfer knowledge and academic publications account for more than 73% of the citations in the US industry patents (Narin et al., 1997). Moreover, Cohen et al. (2002) find out that the most important channels for the universities to have an impact on industrial R&D are published papers and reports.
Co-operation in graduate education involves advanced training for enterprise staff and exchanged of research staff between universities and industries (such as PhD students). Authors argue that the employment of university researchers is a way to effectively transfer knowledge from university to industry, especially in technological and knowledge intensive sectors, such as chemistry and biotechnology (Meyer-Krahmer and Schomoch, 1998; Zucker et al., 2002; Gubeli and Doloreux, 2005). Schartinger et al. (2001) argue that the mobility of human capital, both via employment of skilled people and via co-supervision of PhDs is the most frequent and most beneficial channel for knowledge transfer. Examples of such practices are also student placements and exchanges, or internships that have an impact on university curriculum and at the same time allow firms to tap into the latest thinking in university research labs and arrive at a sense of how science is evolving and the possible implications for production technologies. Argote and Ingram (2000) argue also that an important way in which knowledge is transferred from the higher education sector into industry is through the skills and experience gained by graduates and researchers.
The founding of *spin-off companies* from universities represents a major innovation in the economy, where technology-oriented firms that employ researchers from the science-base generate innovation and income to the economy. Spin-off companies provide benefits in terms of: (1) access to new technology and technical know-how; (2) access to markets; and (3) competitive positioning
(Hladik, 1988).
Each of these modes of knowledge transfer are associated with different forms of intermediation. Hellman (2005) has developed a formal theory about the seeking and matching process between university‘s researchers and the industry, called ‘science-to-market gap’. In this theory there are two possible scenarios. On one hand, researchers and inventors rarely know what kind of industrial applications may exist for their scientific discoveries. On the other hand, industries are often unaware which scientific discoveries might help them to solve their problems and address their needs. In this model, the intermediaries are bridging the gap between the science and the market through additional value added by searching for innovations and translating their findings into business opportunities for firms. Intermediaries that bridge the ‘science-to-market gap’ can be either individuals, or organisations from the private and the public sector, offering communication and consultation services.
A series of informal contacts between industry and university can emerge also during meetings and conferences in which researchers, managers and boundary-spanning agents can meet together and form relationships. In technology intensive sectors science exhibitions and PhD research are the principal channels through which new knowledge enters the commercial domain (Zucker et al., 1998; Shane, 2002). Hussler and Ronde (2007) show that University Industry Linkages (UILs) based upon proximity arise from epistemic knowledge creation oriented networks and communities of practice sharing tacit knowledge. The co-location of firms around universities is also facilitated by the existence of a host of supporting intermediaries providing technical support and other services (see Robinson et al., 2007).

Conclusions

The locus of innovation is to be found in networks and partnerships and not in individual firms (Powell et al., 1996). Intermediaries facilitate this innovation and the KTT activities by the virtue of their specialised resources. Intermediates exist to provide specific resources and to play specific roles that individual members either cannot provide, due to a lack of possessing the necessary resource(s), or are unwilling to provide, because of the negative economic costs associated with obtaining and deploying the necessary resource(s) Johnson (2008). Some Knowledge intermediaries are better at dealing with codified knowledge, others with tacit knowledge, and some intermediate both kinds.
This facilitation provided by intermediaries in KTT activities requires absorptive capacity of the firms that represent the recipients of knowledge. The concept of absorptive capacity was introduced by Cohen and Levinthal (1989, 1990) and it refers to a firm‘s ability to recognize, assimilate, and apply new scientific information for the purpose of innovation and new product development. Intermediaries assist firms in complementing their absorptive capacity by adding knowledge or financial resources. Agrawal‘s studies on university-industry linkages underline the particular importance of absorptive capacity with respect of tacit knowledge. He points out that the transfer of tacit

knowledge is a central issue, in that it accounts for the majority of the variance in terms of the relative abilities of firms to utilize university inventions effectively. Gertler (2003) also argues that the absorptive capacity must first be established to absorb tacit and codified knowledge in the right balance, and then to enables intermediaries to help create more fruitful universityindustry linkages.

Bibliography

Agrawal, A. (2001) ‘University-to-Industry Knowledge Transfer: Literature Review and Unanswered Questions’, International Journal of Management Review, 3 (4), 285–302.
Agrawal, A., and Henderson, R. (2002) ‘Putting Patents in Context: Exploraing Knowledge Transfer from MIT’, Management Science, 48 (1), pp. 44-60.
Antonelli, C. (1999) The Microeconomics of Technological Systems. Oxford University, Press.
Argote, L. and Ingram, P. (2000) ‘Knowledge Transfer: A Basis for Competitive Advantage in Firms’, Organizational Behavior and Human Decision Processes, 82(1), pp. 150-169.
Bendor, J. (1990) ‘Formal Models of Bureaucracy: A review’, in N. B. Lynn and A. Wildavsky (Eds.), Public Administration: The State of the Discipline (pp. 373-417), Chatham, NJ: Chatham House.
Bramwell, A., and Wolfe, D. (2008) ‘Universities and Regional Economic Development: The Entrepreneurial University of Waterloo’, Research Policy, Vol. 37, pp. 1175-1187.
Bruckner, E., Ebeling, W., Jimenez, M., Scharnhorst, A. (1994) ‘Hyperselection and Innovation Described by a Stochastic Model of Technological Evolution’, in: Leydesdorff, L., Van den Besselaar, P. (Eds.), Evolutionary Economics and Chaos Theory: New Directions in Technology Studies. Pinter, London, 79-90.
Cannon, T., (1994) Corporate Responsibility. A textbook on Business Ethics, Governance, Environment: Roles and Responsibilities. Pitman, London.
Cohen, W. and Levintal, D. (1989) ‘Innovation and Learning: the Two Faces of R&D’, Economic Journal, 99: 569-596.
Cohen, W. and Levintal, D. (1990) ‘Absorptive Capacity: a New Perspective on Learning and Innovation’, Administrative Science Quarterly, 35: 128-152.
Cohen, W., Nelson, R. and Walsh, J. (2002) Links and Impacts: the Influence of Public Research on Industrial R&D’, Management Science, 48 (1): 1-23.
Cowan, R., Foray, D. (1997) ‘The Economics of Codification and Diffusion of Knowledge’, MERIT, Maastricht.
Dodgson, M. and Bessant, J. (1996) Effective Innovation Policy: a New Approach. London, Thomson.
Etzkowitz, H., and Leydesdorff, L. (1995) ‘The Triple Helix, University-Industry-Government Relations: a Laboratory for Knowledge Based Economic Development’, EASST, 14: 14-19.
Fligstein, N., Freeland, R. (1995) ‘Theoretical and Comparative Perspectives on Corporate Organization’, Annual Review of Sociology, 21: 21– 44.
Frances, J. et. al. (1991) Introduction, In: Thompson, G. et. al. (ed.) Markets, Hierarchies and Networks: The Coordination of Social Life, Sage Publ., London.
Frenken, K. (2000) ‘A Complexity Approach to Innovation Networks. The Case of the Aircraft Industry (1909-1997)’, Research Policy, 29 (2): 257-272.
Garella, P. (1980) ‘Adverse Selection and the Middleman’, Economica, New Series 56 (223): 395–400.
Gehrig, T. (1993) ‘Intermediation in Search Markets’, Journal of Economics and Management Strategy 2 (1): 97–120.
Gertler, M. (2003) ‘Tacit Knowledge and the Economic Geography of Context, or the Undefinable Tacitness of Being (There)’, Journal of Economic Geography, 3 (1): 75–99.
Gubeli, H. and Doloreux, D. (2005) ‘An Empirical Study of University Spin-off Development’, European Journal of Innovation Management, 8 (3): 269-282.
Hellman, T., Puri, M. (2002) ‘Venture Capital and the Professionalization of Start-up Firms: Empirical Evidence’, The Journal of Finance, 57 (1): 169–197.
Hellman, T. (2005) ‘The Role of Patents for Bridging the Science-to-Market Gap’, NBER working paper No. 11460, Cambridge, Mass.
Hill, C., Jones, T. (1992) ‘Stakeholder-Agency Theory’, Journal of Management Studies, 29, 134–154.
Hill, J. (1985) ‘Why so Much Stability? The Role of Agency Determined Stability’, Public Choice, 46: 275-287.
Hladick, C. (1988) ‘Development of New Skills in the University Communities’, Research Policy, 13: 214-237.
Hussler, C., and Ronde, P. (2007) ‘The Impact of Cognitive Communities on the Diffusion of Academic Knowledge: Evidence from the Networks of Inventors of a French University’, Research Policy, 36 (2): 288-302.
Jensen, R., and Thursby, M. (2004) ‘The Academic Effects of Patentable Research’, NBER working paper No.

10758, Cambridge, Mass.
Justman, M., and Teubal, M. (1996) Technological Infrastructure Policy (TIP): Creating Capabilities and Building Markets', In: Teubal M. et. Al. (eds.). Thecnological Infrastructure Policy: An International Perspective, Dordrecht, Kluwer.
Kolfsten M., Dylan, J. and Carina, S. (1999) 'Growing the Linkoping Technopole – A longitudinal Study of Triple Helix Development in Sweden', Journal of Technology Transfer, 24: 125-138.
Levacic, R. (1991) 'Markets: Introduction', In: Thompson, G. et. al, (ed.) Markets, Hierarchies and Networks: The Coordination of Social Life, Sage Publ., London.
Levy, R., Roux, P. and Wolff, S. (2009) An Analysis of Science-Industry Collaborative Patterns in a large European University', Journal of Technology Transfer, 34: 1-23.
Leydesdorff, L (2001) A Sociological Theory of Communication: The Self-Organization of the Knowledge- Based Society', Parkland, FL: Universal Publishers.
Leydesdorff, L. (2006) The Knowledge-Based Economy and the Triple Helix Model. Edward Elgar.
Leydesdorff, L. and Etzkowitz, H. (1998) 'The Triple Helix as a Model for Innovation Studies', Science & Public Policy, 25(3): 195-203.
Leydesdorff, L. and Van den Besselaar, P. (1998) 'Competing Technologies: Lock-ins and Lock-outs. In: Dubois, D.M. (ed.), Computing Anticipatory Systems, Prooceding of the American Institute of Physics, 437: 309-323, American Institute of Physics, Woodbury, NY.
Lissenburgh, S. and Harding, R. (2000) Knowledge Links: Innovation in University / Business Partnerships. London: IPPR.
Luhmann, N. (1984). Soziale Systeme. Grundrib Einer Allgemeinen Theorie. Frankfurt a. M.: Suhrkamp.
Malerba, F., Nelson, R., Orsenigo, L. & Winter, S. (1999) '"History-Friendly" Models of Industry Evolution: The Computer Industry', Industrial and Corporate Change, 8(1): 3-35.
McLane, S. 1996. 'Should Universities Imitate Industry?', American Scientist 84 (6): 520-521.
McNutt, P. (2002) Economics of Public Choice. Edward Elgar.
Meyer-Krahmer, F., Schmoch, U. (1998) 'Science-based Technologies: University–Industry Interactions in Four Fields', Research Policy, 27, 835–851.
Monjon, S., Waelbroeck, P. (2003) 'Assessing Spillovers from Universities to Firms: Evidence from French Firm-Level Data', International Journal of Industrial Organization, 21: 1255–1270.
Mueller, D. (2003) Public Choice. Cambridge University Press.
Narin, F., Hamilton, K. and Olivastro, D. (1997) The Increasing Linkage Between U.S. Technology and Public Science', Research Policy, 26: 317–330.
Parkinson, J. (1994) Corporate Power and Responsibility. Oxford University Press, Oxford.
Robinson, D., Rip, A., and Mangematin, V. (2007) 'Technological Agglomeration and the Emergence of Clusters and Networks in Nanotechnology', Research Policy, 36 (6): 871-879.
Roessner, J. (1993) 'What Companies Want from the Federal Labs', Issues in Science and Technology, 10 (1): 37-42.
Rubinstein, A.,Wolinsky, A. (1987) 'Middlemen', The Quarterly Journal of Economics, 102 (3): 581–593.
Russell, G. and Waste, R. (1998) 'The Limits of Reinventing Government', American Review of Public Administration, 28 (4): 325-346.
Schartinger, D, Schibany, A., and Gassler, H. (2001) 'Interactive Relations Between University and Firms: Empirical Evidence for Austria', Journal of Technology Transfer, 26: 255-268.
Schartinger, D., Rammer, C., Fischer M. M., and Frohlich J. (2002) 'Knowledge Interactions Between Universities and Industry in Austria: Sectoral Patterns and Determinants', Research Policy, 31: 303-328.
Selden, S., Brewer, G. and Brudney, J. (1999) 'The Role of City Managers: Are They Principals, Agents, or Both?', American Review of Public Administration, 29 (2): 124-148.
Shane, S. (2002) 'Selling University Technology: Patterns from MIT', Management Science, 48 (1): 122-137.
Solomon, J. and Solomon, A. (2004) 'Corporate Governance and Accountability', John Wiley & Sons, Chichester.
Swann, G. (2002) Innovative Business and the Science and Technology Base: An Analysis Using CIS3 Data Report for the Department of Trade and Industry. DTI, London, UK.
The Cadbury Code (1992) Report of the Committee on the Financial Aspects of Corporate Governance: The Code of Best Practice. Gee Professional Publishing, London.
Thursby, M., Thursby, J. and Mukherjee, S. (2005) 'Are There Effects of Licensing on Academic Research? A Life Cycle View', NBER Working Paper No. 11497, Cambridge, Mass.

Todeva, E. (1998) ‘The Transformation of the Socialist Governance System’, South Bank European Papers, 6 98, London.

Todeva, E. (2005) ‘Governance, Control & Co-Ordination in Network Context: The Cases of Japanese Keiretsu and Sogo Shosha’, *Journal of International Management*, Vol. 11, pp. 87-109.

Todeva, E. (2010) ‘Theoretical Tensions between Regulation, Governance, and Strategic Behaviour in a Federated World Order’, *International Journal of Social Economics*, 37 (10): 784- 801.

Tricker, R., (1984) Corporate governance: practices, procedures and powers in British companies and their boards of Directors. Gower Press, Aldershot, UK.

Wilson, W. (1987) ‘The Study of Administration’, Political Science Quarterly, 2,197-222.

Windrum, P. (1999). Simulation models of technological innovation: a review. American behavior scientist, 42 (10), pp. 1531-1550.

Yusuf, S. (2008) Intermediating Knowledge Exchange Between Universities and Businesses’, Research Policy, 37: 1167-1174.

Zucker, L. G., Darby, M.R., and Armstrong, J.S. (2002) ‘Commercializing Knowledge: University Science, Knowledge Capture, and Firm Performance in Biotechnology’, Management Science, 48 (1): 138-153.

Zucker, L., Darby, M., Brewer, M. (1998) ‘Intellectual Human Capital and the Birth of U.S. Biotechnology Enterprises’, American Economic Review, 88 (1), 290-306.

FRAMING STS IN THE DEVELOPMENTAL CONTEXT: A POST-TRIPLE HELIX APPROACH

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Abstract
For the past three decades or so, the field of Science and Technology Studies, hereafter STS, has shed light on the interrelationship between modern science and technology, on one side, and society, on the other. As an interdisciplinary field, STS takes advantage from multiple methods, multiple approaches, and multiple intellectual tools, to critically examine not only how technoscientific products have impacted modern societies, but also how a myriad of social, economic, political, and ideological factors come to intervene and direct the production of scientific knowledge and technical systems. Thus, a wide range of technoscientific arenas, from simple artifact such bicycle, bridges, to more advanced products including the internet, medical science, nuclear energy, nanotechnology, and so forth, have been probed and analyzed by STS scholars in such distinctive ways that give us a clearer picture of the role and consequences of science and technology different from how we, intellectuals and public alike, used to understand these modern inventions. Despite what STS scholars have considerably produced to unpack social, political, and cultural relations that underlie the construction of technoscience, a majority of this knowledge and insights are situated in the context of Western societies, or more precisely, in economically and technologically advanced societies mostly in Western Europe and North America (Williams & Edge 1996). Only a tiny portion of attention has been given to issues of science, technology, and society outside these geographical domains. This is due to the fact that science and technology are genealogically modern products that have grown rapidly more in the Western world. There is a number of works that sought to compare scientific knowledge in Western tradition and in Eastern tradition, but this type of work does not pay full attention on the whole structure of relations between modern science and technology, on one side, and developing societies, on the other. As a result, STS seems to be irrelevant, if not disconnected at all, when it comes to the question of how science and technology should be examined and developed in the context of the developing world. Although STS has been predominantly focused on revealing the co-production of technoscience and modern (Western) society, we believe that STS has much to contribute to the discourse of science and technology in the global south, a territory characterized by massive developing processes. Insights from different schools of thoughts in STS are arguably not only relevant but also applicable to unveil the root cause of problems many developing societies are facing today. We understand that when development as a modern project was first introduced to the post-colonial world in 1950s and 1960s, one of the most important elements that came with it was technology (scientific knowledge included as one package). Thus, development not only entailed industrialization and the establishment of modern social and political institutions, it also encouraged the utilization of modern technology to remedy a wide range of problems such as lack of infrastructure, lack of drinking water, etc. In this paper, we would like to bring the STS discourse into the discussion of development and to offer a new perspective that allows us to place technoscience in a proper position within the developing world.
By the same token, what we want to accomplish in this paper is to expose the limitations of a framework, namely the triple-helix that has for the past two decades been strongly influential in dictating how science and technology ought to be build. The success of this framework in analyzing the extensive production of science and technology in developed economies prompted many researchers to employ this approach in studying how science and technology can be developed through similar mechanisms found in Western systems. We argue that the triple-helix framework, despite its claimed advantages in deciphering institutional structures underpinning science and technology production, carries some limitations that should be overcome. In this paper, we seek to offer a new perspective, one that is drawn on the STS scholarship and goes beyond the triple-helix spectacle, a post-triple helix approach.The article is divided into three sections. In the first section, we will give a short historical account of the development of STS as an interdisciplinary field that seeks to unravel processes through which science and technology are produced. We highlight some of the prominent figures and concepts that make up the STS scholarship and discuss how these concepts are relevant to examine science and technology in the developmental context. In the second section, we shift our discussion to the triple-helix in which we shows how this framework has been widely used in science and technology policy. In this section, we identify shortcomings of this framework in understanding science and technology in the developmental context. The last section offers a new perspective for looking at science,

technology, and development. In this section, we attempt to frame STS in the developmental context and to formulate an STS-informed framework that, we hope, enables researchers to view the problem of science and technology from a different perspective.

Keyword: Epistemological and Cultural Limitations, Science and Technology Studies, Developing Countries

Introduction

For the past three decades or so, the field of Science and Technology Studies,[1] hereafter STS, has shed light on the interrelationship between modern science and technology, on one side, and society, on the other. As an interdisciplinary field, STS takes advantage from multiple methods, multiple approaches, and multiple intellectual tools, to critically examine not only how technoscientific products have impacted modern societies, but also how a myriad of social, economic, political, and ideological factors come to intervene and direct the production of scientific knowledge and technical systems. Thus, a wide range of technoscientific arenas, from simple artifact such bicycle, bridges, to more advanced products including the internet, medical science, nuclear energy, nanotechnology, and so forth, have been probed and analyzed by STS scholars in such distinctive ways that give us a clearer picture of the role and consequences of science and technology different from how we, intellectuals and public alike, used to understand these modern inventions.

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Although STS has been predominantly focused on revealing the co-production of technoscience and modern (Western) society, we believe that STS has much to contribute to the discourse of science and technology in the global south, a territory characterized by massive developing processes. Insights from different schools of thoughts in STS are arguably not only relevant but also applicable to unveil the root cause of problems many developing societies are facing today. We understand that when development as a modern project was first introduced to the post-colonial world in 1950s and 1960s, one of the most important elements that came with it was technology (scientific knowledge included as one package). Thus, development not only entailed industrialization and the establishment of modern social and political institutions, it also encouraged the utilization of modern technology to remedy a wide range of problems such as lack of infrastructure, lack of drinking water, etc. In this paper, we would like to bring the STS discourse into the discussion of development and to offer a new perspective that allows us to place technoscience in a proper position within the developing world. By the same token, what we want to accomplish in this paper is to expose the limitations of a framework, namely the triple-helix that has for the past two decades been strongly influential in dictating how science and technology ought to be build. The success of this framework in analyzing the extensive production of science and technology in developed economies prompted many researchers to employ this approach in studying how science and technology can be developed through similar mechanisms found in Western systems. We argue that the triple-helix framework, despite its claimed advantages in deciphering institutional structures underpinning science and technology production, carries some limitations that should be overcome. In this paper, we seek to offer a new perspective, one that is drawn on the STS scholarship and goes beyond the triple-helix spectacle, a post-triple helix approach.

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[1] STS is also referred to as Science, Technology, and Society.

looking at science, technology, and development. In this section, we attempt to frame STS in the developmental context and to formulate an STS-informed framework that, we hope, enables researchers to view the problem of science and technology from a different perspective.

Opening the Black Box: A Methodological Perspective

It is during the heyday of modernization that social thinkers began to ponder the impacts and influences of scientific knowledge to contemporary societies. Social studies of science and technology, which later evolved into the field of STS, embarked upon a project that sought to locate scientific institutions in modern society. In this account, one has to mention Robert Merton who due to his pioneering work on sociology of science is considered the founder of STS. His study on the scientific norms that underpinned the institution of science laid the foundation of STS as a social scientific field (Merton 1973). Drawing on the American functionalist approach, Merton's study identified certain social conditions in which science as a social institution would flourish and significantly supported the stability in society by playing a pivotal role in knowledge production. Thomas Kuhn later extended Merton's inquiry into the institution of science. However, the foundation of STS Merton has established underwent a shift when Thomas Kuhn published his seminal work *The Structure of Scientific Revolutions,* which surprisingly showed that scientific communities were not as normative and unified as Merton had depicted (Kuhn 1970). The notion of "paradigm" began to occupy the discourses of social and historical studies of science and informed many studies on science and its application even went beyond the field. Although Kuhn's concept of scientific revolution has been criticized for a lack of empirical base, *The Structure of Scientific Revolutions* remains an influential text among STS researchers. Certainly there are other figures in addition to Merton and Kuhn who contributed to the birth of social studies of science. Imre Lakatos, Karl Popper, Karl Mannheim, and German thinkers affiliated with the Frankfurt School are among those whose works set the ground for the emergence of STS (Hess 1997:1114). We may say that all of these works led to one conclusion that science, as a human enterprise is social in nature in a sense that its institution is always situated within social, cultural, and political context. This entailed the possibility for us to study institutional aspects of science as part of our attempt to understand the characteristic of modern society.

STS began to take shape as we see it today when a group of sociologists sought to challenge Mertonian sociology of science in defining and describing the scientific enterprise. After decades of dominance, Merton's description of the institution of science was shook up after scholars and social thinkers saw the impact of science and technology on human conditions. The extensive use of scientific knowledge in military and profit-making corporations precipitated criticisms against the idealized picture of science Merton had drawn in the sociology of science. Many thoughts suggest that what Merton did was less to portray the reality of science than to reinforce the ideology of science. In response to the failure of the institutional sociology of science in explaining how precisely scientific knowledge is related to social factors, the new sociology of science emerged out of a conviction that social scientific tools were applicable not only to explain the formation and development of scientific institutions, but also to go deeper into the very production of scientific knowledge, a domain considered to be deeply cognitive thus beyond sociological inquiry by Merton and his contemporaries. Also known as the Sociology of Scientific Knowledge (SSK), this school of thought in the sociology of science took a brave step into the process of scientific production and probed how scientific knowledge is inherently social. The Strong Programme was one of the major projects in this line of inquiry, which sought to challenge conventional tradition in the sociology of science. This new branch of the sociology of science basically revolves around the argument that all forms of scientific knowledge are rooted in social spheres and it is possible for sociologists to trace back the root of knowledge in social structures and relations. Four basic tenets, namely causality, impartiality, symmetry, and reflexivity, were offered as the main components in SSK (Bloor 1976). Resorting to social constructivism, the chief agenda of SSK lies in the attempt to open the black box of science and to see how scientific knowledge is socially constructed.

STS took a step further in opening the black box of science when a group of sociologists adopted ethnomethodology to study science from a micro-sociological view (Whitley 1972). Informed by works of leading anthropologists such as Bronisław Kasper Malinowski and Claude Lévi-Strauss who had studied tribal societies in non-western cultures, STS scholars created a new approach in revealing the intricate process of knowledge production right from its very place, namely the laboratory (Hess 1997:100). This is a site where scientists are directly engaged in the world seemingly isolated from the social sphere. STS scholars thus delved into this world driven by curiosity to explore social and cultural interactions established among individual scientists and their constructed environment. Laboratory studies, as it is called, proved to be effective for STS scholars to disentangle complex process of scientific production involving scientists and their instruments. By studying activities in the laboratory, STS researchers were able to answer one big question: What does the culture of science look like? This question is crucial to be answered because it brings out cultural features that are embodied in scientific activities. It resulted in the notion of science as an activity that relies on manufactured reality, a term that refers to the assemblage of instruments, human individuals, and materials making up the laboratory. The assemblage of these components is certainly unique in every place and every context and it is replete with symbolic elements that allow scientists to make meaning from their scientific investigation and impose it on knowledge. Learning from social realities in the laboratory that shape and influence the production of scientific knowledge, STS scholars out forth an argument that the notion of science as a universal product may not be as strong as it was assumed by those who conducted scientific practices. What empirical studies on the laboratory showed is not only that scientific knowledge is always social. More importantly, it is culturally situated and locally produced. This means that in scientific formulae, concepts, and theories are constructed out of specific and peculiar conditions that may not be universal. This is not, however, to say that the universality claim has no grounds to stand up. Neither is it to claim relativism in science. The underlying argument is that local realities play a role in allowing scientists to accomplish their scientific goals and that it is these realities that have been largely ignored in the sociological explanation of science.

STS became a well-rounded field after technology was included in this inquiry. This is marked by the work of sociologists who focused their attention on the relationship between technology and society. In a common view, technology is often seen an autonomous force that ignites changes in society (Winner 1977). Labeled as technological determinism, this dominant view had influenced experts, policymakers, media, and public in general in the way they construe the role of technology in society. Thus, technology is considered an entity that carries its own logic, that is, technical rationality, and that it develops following a trajectory independent from social realities. Challenging this assumption, STS scholars provided a myriad of empirical materials that demonstrated social, cultural, and political components imbued in the construction of technology. They successfully debunked the idea that technology runs on its own rationality. The Social Construction of Technology, known as SCoT, is among many approaches within the STS scholarship that brought up the notion of technology as socially constructed, thus subject to sociological inquiry (Bijker et al, 1987). This approach put forth the argument that rather than develop in a linear fashion, technology takes its form though a process shaped by a multitude of social variables, running on a non-linear trajectory. Adding to the social construction of technology was a notion that technology is deeply political in nature. Langdon Winner's most celebrated essay *Do Artifacts Have Politics?* opened up a new discussion in STS in which technology is no longer understood as neutral but it is examined within the question of power and authority (Winner 1986). This signified STS's complete foray into science and technology and solidified the framework of STS as an interdisciplinary field that enables us to critically examine what lies inside the black box of science and technology.

One question arises here: How are the insights STS scholars have provided through empirically grounded studies rendered relevant to problems of the developing world in relation to science and technology? Science and Technology have been prevalent in development since this modern project was first introduced to the Third World over six decades ago. A great number of developmental projects carried out transnational institutions and governmental agencies in developing countries are essentially aimed to apply scientific and technological knowledge and systems to make substantial improvements in the livelihood of the Third World people. Thus, what we see is large-scale mobilization of scientific and technological resources from developed to developing areas. Transfer of technology is the main theme of this measure. However, when science and technology travel from one location to another, there are many cases that simply demonstrate that discrepancy between the transferred system of science and technology and local conditions of the destination country strikingly emerged. Such a discrepancy, which could lead to failure and even catastrophic outcomes, is due to social, cultural, and political features embodied in science and technology. This is where the STS perspective is relevant and useful for us to identify the root cause of scientific and technological failures in development and even to offer a remedy to fix this problem. We will get to this point after we discuss the shortcomings of the Triple-Helix in the following section. The bottom line is that successful application of science and technology in the developmental context requires a framework that can bridge social, cultural, and political dimensions embedded in science and technology and those of local communities.

Limitations of the Triple Helix

The Triple Helix model emerged from a workshop named Evolutionary Economics and Chaos Theory: New Directions in Technology Studies organized with the intention of crossing the boundaries between institutional analyses of the knowledge infrastructure on the one hand and the evolutionary analysis of the knowledge base of economy, on the other (Leydesdorff & Meyer 2006). The basic question which the creators of the Triple Helix framework attempted to answer is how can co-evolution between layers of institutional arrangements and evolutionary functions be conceptualized in relations to the division of innovative labor among both institutions and functions? . Triple Helix has been the standard metaphor for describing innovation in a formalized industrialized knowledge economy over the past two decades although proto-structures of this framework have existed since the 1960's in the United States especially along Route 128 and Silicon Valley (Ezkowitz 2008:86). Triple Helix as a conceptual scaffold has been utilized extensively for seeding institutional mechanisms for innovation on an organizational level. As this framework as three pillars; academia, industry and the government, they connect in a particular configuration for regional development. Triple Helix has widely been used as a conceptual tool to study innovation patterns in developed economies particularly in the context of regional economic development and normal science. The triple helix captures this transformation of roles and relationships as intertwined spirals with different relations to each other.

Triple Helix mechanism extended the war-era collaboration between academia and government to the next level, when the synergistic potential for growth apart from traditional mandates of the actors in question. The fundamental role of the university as an institution for the production and transmission of knowledge remains its core mission. Central to the Triple Helix paradigm is the concept of knowledge clusters and the 'entrepreneurial' university. Silicon Valley, Boston, Cambridge (UK) and Singapore all herald the coming of age of the knowledge cluster economy.

Thus universities continue their unique objective of nation building and dissemination of knowledge. Similarly, government is the 'Chief Arbitrator' supervising social and legal regulations of the land and industry is the primary source of capital generation and accumulation as Marx said. Thus industry continues to produce goods and services and also does commercially viable applied research, but increasingly provides training at higher levels, reflected in the fact that many organizations have university scale training campuses as Infosys in India to retrain thousands of graduates. Government is responsible for laying down ground rules i.e. regulatory mechanisms but also makes available venture capital to help start new enterprises such as the Singapore Government via the Economic Development Board.

There are three main configurations in the Triple Helix framework, which are the Statist Model, Laissez Faire Model and the Hybrid Model. In the Statist Model, the government is the fundamental driver of the movement as in China and Singapore. In the 1960's the Argentinean physicist Jorge Sabato proposed a "triangular" science and technology policy model, applying the statist model to a developing country, arguing that only government had the ability and resources to take the lead in coordinating the other institutional spheres to create science- based industry (Viale &Ezkowitz 2010).

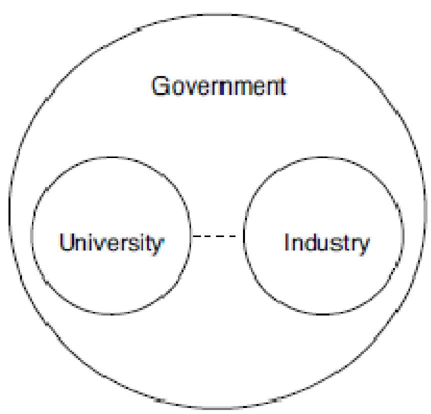

Fig. 1. The Statist Model of Triple Helix Innovation (Ezkowitz 2008:12)

In the Laissez Faire model, institutional spheres have strong boundaries and are expected to serve their respective agendas such as universities should focus on knowledge production. The Laissez Faire model is particularly evident in the United States as regimes for legal protection are robust and a 'culture for non interference 'from the State is prevalent (Ezkowitz 2008:15). The hybrid models with overlaps in interests between the various stake holders in the framework are present in countries with a more democratized approach; a vibrant civil society apparatus. This is the standard Triple Helix Framework. The evolution of this model from two diametrically opposite ends; the statist and the laissez faire model has resulted in the standard model of the Triple Helix.

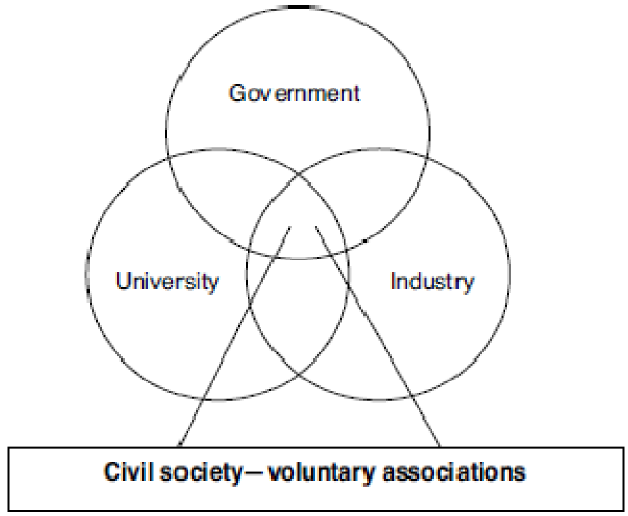

Fig. 2.The Triple Helix Framework for Government-University-Industry relations for Innovation (Viale 2010: 294)

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Triple Helix as a knowledge domain has grown over the last decade with the Triple Helix Organization, organizing annual conferences globally to promote research in this domain along with having a dedicated journal. There are centers for the study of Triple Helix Innovation all over the Globe. Many emerging and developing economies have tried to replicate the 'Triple Helix' model in bits and patches as the cultural software necessary for the Triple Helix to flourish in these countries are severely missing. The drawbacks of the Triple Helix approach with respect to its implementation in the developing world will be shed light upon in the latter part of this section.

Some aspects have of the Triple Helix framework has been incorporated within the developmental structures of emerging economies. The organizational model of the incubator was adopted by developing Latin American economies such as Brazil and Mexico from the United States. In the United States, incubators sprang up as a support structure geared towards aiding individuals or groups of entrepreneurs in the commercialization of research via the creation of new companies. In Brazil and Mexico, incubators have been used as an instrument of policy to diminish poverty through professional training and the creation of income-generating opportunities for socially and economically marginalized groups (Saad and Zawadie 2011: 176). In recent history, the formation of 'Innovation Parks' or clusters for growing a knowledge based economy has been a popular import from the industrialized world.

As the number of actors and levels of initiative increase among the triple helix players, a meta- innovation system is created. The premise for the growth of such a dynamic is an active civil society in which initiatives are encouraged from various parts of society. The possibility of individuals and groups to freely organize, debate, and take initiatives is the basis for a triple helix including bottom- up as well as top- down initiatives. An open civil society paves the way for Triple Helix actors to organize and to overcome blockages to the transformation of knowledge to innovation.

The Triple Helix Model suffers from three kinds of lacunae in other to it effective and impactful in the developmental ethos. These are categorized in to their distinctive compartments. These Structural inefficiencies, Cultural inadequacies and Epistemological challenges which hinder the translation of the Triple Helix model to the developing world fabric in a lot of countries; the Government is the principal player such as in Singapore and China i.e. the Statist model. Triple Helix Model works in places where the three ingredients of Talent, Capital and Market Access are all readily available. It usually takes place in Tax Free Zones, usually created in the developing world after rural folk, who have no livelihood alternatives other than tilling the land. This has major Sociological implications. The market system under the ideological regime of capitalism, gives importance to the creation of private property, which gives incentives to the innovative capabilities of researchers and inventors. The Triple Helix Framework is a neo-liberal narrative; its energies are targeted towards the accumulation and concentration of capital

The existing Triple Helix structure will only encourage research towards ends the direction which yields financial profits and not do research for 90% of the world's population who cannot afford to pay market rates for the technological solution. A brief illustration can be that the research labs in so called 'entrepreneurial' universities, would concentrate on research for solutions for ageing issues in developed countries rather than focus on equatorial vector borne diseases which kills millions, because their clientele cannot afford such medication.

In most of the developing countries, Universities are essentially for teaching purposes. The create the manpower for local economic ends. Research in Scientific Research and Development is a luxury, as governments have more pressing needs to deal with. There is a sense that this gap in access to scientific knowledge, leads to deprivation and is a fertile territory for discontentment. In fact, technology can be a facilitator in the alleviation of poverty in the developing world via agricultural biotechnological breakthroughs for seeding a second Green Revolution, if they have access to hybrid seeds whose patents are owned by Western Multinational companies. More people can survive curable diseases if they have access to affordable and accessible healthcare.

Scientific knowledge in itself cannot be a panacea for development. It needs to be enabled within architecture of societal facilitation, and the current Triple Helix Model has severe limitations in order to translate the innate potential of techno-scientific knowledge for the betterment of humankind. One of the fundamental shortcomings of the Triple Helix approach is regarding the fundamental focus of the entire emphasis of knowledge production for monetization i.e. patents. The stress on commercialization of research in patents and products, which the poor cannot afford, limits access at the source. Some forms of techno-scientific knowledge for healthcare and agriculture are sacred for survival for the farmer in rural Bangladesh. It has been observed, that the Government funds University research labs, regulates the market friendly environment and on the same page many times, subsidizes critical medication for their floundering public health systems. The Government is the main actor in this play of innovation. The focal question that arises here is- *Has the Triple Helix model failed in utilizing techno-scientific knowledge for development*?

The critical recipe for success was the presence of a critical mass of factors such as a vibrant business environment, research talent and strong government buffer. These elements are just not present in a generous helping, in the developing world. Science and Technology for development requires a new intellectual regime in order to be effective. The proliferation of techno-scientific knowledge to the grassroots is the main challenge and the incorporation of Civil Society partners to the evolved Triple Helix Model addresses the lacunae of the profit orientation of the existing conceptual framework. The Third Sector is the pillar which converts policy prescriptions into program implementation. Science and Technology can alter the landscape in places where hope for change was fairly limited.

There are significant epistemological challenges arising from the existing Triple Helix model, for it to be implementable in a developmental context. Techno-scientific Knowledge is a legacy of the mind. It converts itself from an idea in to a device which is used to improve people's lives. Technology is an impulse, a thought form, before anything it has to do with tools.

In the software industry, extensive portfolios of legal rights are considered means for entry deterrence and for infringement and counter- infringement suits against rivals. For example, the core technologies of ICT – including transistors, semiconductors, software and telecommunication technologies like the mobile phone – were developed under weak IPR regimes (Viale & Ezkowitz 2010:173). The organizational effect of the epistemological structure of knowledge is evident in some science- based innovations, such as biotechnology, in particular biopharmaceuticals. The high level of interdisciplinary between biotechnology and biochemistry, informatics, mathematics, nanotechnology, biophysics, immunology and so on makes the knowledge very unstable. The potential problem-solving resulting from the intersection, hybridization and conceptual recombination of different and connected models and theories is very high. Thus there are many innovative solutions that continuously transform the field.

There is a phenomena of the 'tragedy of the anti-commons' is likely to come into force when Intellectual Property regimes give too many actors the right to exclude others from using fragmented and overlapping pieces of knowledge with no one having the effective authority over the knowledge fragments. Culture of IP Protection is a cultural issue; creation of knowledge for humanity is not popular in the era of monetization of knowledge, when one's peers are doing it for the financial rewards. Knowledge can codify the essence of information and codified knowledge can be commercialized.

The third impediment in perspective is the cultural factors in the assimilation of techno-scientific knowledge in the third world. The science and technology that is being developed is primarily science birthed out of a western concept. Technology is always for society and not the other way around, as it is quintessentially social product. Local knowledge is vital in socializing the technology for implementation in a particular context. Background knowledge about culture and tradition can give the agency responsible for inoculating the technological device or service and even a combination of the two, as in a case of healthcare.

The intrinsic cultural dynamics of a society, affect how science is treated as a tour de force in the context of development. A culture which appreciates risk taking and questioning would be far more conducive for scientific research than a society which holds traditions as sacrosanct. Indigenous knowledge can be the source of effective techno scientific innovations as better bottom up understanding of the grassroots culture is the game changer in translating theory into action.

Policy Implications and Directions for Future Research

As discussed in the previous section, there are a number of limitations of the existing framework of science being put at work for the cause of development. These limitations can be nomenclaturized into three distinct categories, namely structural, epistemological and cultural. Structural factors refer to forms of relations that link organizations of science and technology to other social and political institutions. The production and development of science and technology are largely shaped by political economic structures, which often result from long historical process whereby local dynamics is crucial in the construction of social structures. What we would like to bring here is that the production and development of science and technology are always part of power relations embedded in social structures. As Michel Foucault has revealed, the core of knowledge production lies in the struggle of power that involved different groups and the accumulation of knowledge is necessarily part of the accumulation of power. This is congruent to what Pierre Bourdieu explained in his notion of the field. The field, according to Bourdieu, is a sort of domain where different social groups with different interests and ideologies come to engage in the activities of exchange of different form of capital (Bourdieu 1986). Yet, the ultimate end of every single actor in the field is to accumulate power that comes along with acquisition of knowledge. We would like to extend how Foucault and Bourdieu have described knowledge production as part of structure and power relation to a level that transforms the conventional approach of Triple-Helix into a more comprehensive structure that is not limited to three institutions that make up the triple helix. This entails abandoning the simple structure of the Triple Helix and expanding the notion of structure, which includes any actor, entity, and group in society potential to contribute to the development and application of science and technology for developmental purposes.

Invoking the Pierre Bourdieu notion of capital, sometimes economic and cultural capital will tilt the balance of power towards using science for private ends and not for the wider cause of humanity at large. In an adjoining concept of the ‘Field’, Bourdieu suggests that the position of the stakeholder in the developmental paradigm (Field) is a function of its Habitus, Capital and any specific rules of the Field (Bourdieu 1977). Power dynamics between various stakeholders are determined vis-à-vis mechanics between the various fields of the heterogeneous actors at play to appropriate scarce resources. This is very apt in a developing country context. An important observation aggravating the developmental divide, is that different stakeholders, share a different Habitus and to bring all relevant actors to the table on the same page is a challenging proposition to say the least.

Whenever, there is a discourse on knowledge for the beneficiation of society, there is a question of power relations. According to Foucault, knowledge is a source of power (Sheridan 1980). A particular social class, manipulate interests through the exercise of power through knowledge creation and implementation. There are many diverse, heterogeneous actors with differential power potential in a field, which add layers to structural complexity. Power determines the direction of technological politics at the top table of global diplomacy. One of major structural constraints, as pointed out in the earlier section is the overvelhming presence and power of the Modern Day State in the construct of knowledge creation. They are the facilitators for creating the ideal business environment, fund universities and research institutes and sometimes subsidizing knowledge products for consumption by the have-nots. In many developing nations, ‘The State’ is often the only strand of the proverbial triple helix.

Another major set of flaws in the existing system are essentially cultural in character. Science and Technology are cognitive constructs; these are legacies of the mind (Phadke 2005). Science as a form of knowledge is not value neutral (Winner 1979). In fact, Science has been used a weapon of mass murder during the Holocaust. If science was used as an instrument for war in the last century, then the culture in scientific research in towards monetization of every nugget of scientific data. Humanity seems to have been relegated to the cold basket and commercialization is currently the regime of choice in this regard. The cultural values of capitalism seem to have been embedded in the institution of science. Since the establishment of stringent intellectual property rights to scientific discoveries, every patent is squeezed to the limit to extract monetary value out of it. Vital scientific products for human survival, such as Anti Retro Viral medication for AIDS patients are all under long term patent protection. Intellectual Property Rights are for big multinational corporations to earn profits out of them which millions of poor do not have access to affordable health care. In fact, an iron tower called as the intellectual property regime dissuades open source innovation and grass roots bottom up scientific discovery trajectory. Science is indeed for the benefit of humanity and not the other way around.

The conventional model of the triple helix is fairly limited in nature as in the discourse of science and technology; there are a multitude of actors which influence the process of meaning making. The science as culture which we define today is often from a western perspective. Traditional, indigenous forms of knowledge are often not given its right weight and importance in the discourse of science and development. Indigenous forms of scientific knowledge have been around for thousands of years and awareness of local culture is often the threshold frequency for science to jump from a lower energy level orbit to the next in terms of impact of science on humankind. A small anecdote can be stated out here, such as many a time a hydroelectric power dam (classic case of hard science) is built in a rural area in a developing country where the engineers and hydrologist do not have precise details of the topography of area. If the technical team consults local communities who have such better picture of the local conditions, then science can be utilized at its best element.

The final category of limitations of science for development is the methodology of knowledge creation and production, i.e. epistemology. Every branch of science has a unique of research in the process of knowledge creation. Life science and medical research utilizes wet lab methods, computer scientists utilize software and simulation for creating software which make our lives simpler. According to the methodology of research, it will be determined if that form of science can be utilized for developmental purposes at the grassroots. Issues at the developmental grassroots are indeed complex, and individual scientific domains need to collaborate in teams for inter-disciplinary problem solving to be effective, for example- water is a public health issue, which involves environmental engineers, doctors, hydrologists, chemist and even anthropologists to make a cogent strategy for clean, accessible water access.

As Science itself is an institution in itself which shapes society like no other source of persuasion. The model of the triple helix is very basic in its mandate to holistically cover the structural complexities of the knowledge based value creation model for the third world. Power dynamics influence the impact of science for developmental ends.

Finally, the last part of our post-Triple Helix approach touches upon the epistemological dimension of science and technology. This is inescapable because if we are to deconstruct the Triple Helix, it is necessary to delve into this dimension, which constitutes the core of science and technology. Basically, there are two epistemological issues we would like to raise in this regard. The first one is related to the character of knowledge produced in science and technology. As has been examined by a number of philosophers and sociologists of science and technology, modern science and technology are grounded on empirical observation in which objective knowledge are assumed to be drawn from empirically tested observations. This results in formalization of knowledge, which is considered the most valid form of knowledge as it is regarded to represent objective reality. Formal knowledge, however, tends to rule out other forms of knowledge that come from different sources and realms. In a society where social certainties are high, formal knowledge may be prevalent. But in developing societies where conditions are messier and more complex, formal knowledge is likely to be inadequate to capture the whole reality. Hence, what we would like to offer is de-formalization of knowledge in which knowledge production is no longer dominated by processes that take place in laboratories and formal institution of science but it becomes a widely open arena where multiple approaches and sources characterize knowledge systems. This entails bringing up the significance of local knowledge as a sort of epistemology rooted in localities. This is not, however, to relativize knowledge or to subscribe to any sort of relativism because as a few STS scholars have explained, local knowledge is built upon the realism of local circumstances. Thus, validity of local knowledge should not be questionable.

Why is local knowledge significant? Many cases have shown that the direction of science and technology in the developing world is typically pre-determined whereby the role of "external actors" who possess formal knowledge appear dominant in dictating science and technology agendas. The main concern lies in discrepancy between the choice of problems and technical regimes set by these actors and the realities of developing societies. In other words, science and technology are produced to give solutions to tackle wrong developmental problems; the remedy and the problem do not match. To overcome this nagging drawback, we should situate knowledge in the local context and this requires "localization" of knowledge, which can be carried out through a new methodological paradigm that allows local realities to be captured in scientific observation. It is this epistemological change that we would like to offer as package of post-Triple Helix approach. It lies in the ability of the new approach in allowing multiple sources of knowledge to understand complex realities of the developing world. The most immediate implication is that formal institution and methodology of science and technology are no longer the only authority in dictating innovation policy. Participation of multiple actors and utilization of multiple approaches are now advisable to enable science and technology in overcoming development-related issues in the Third World.

Conclusion

As we have described in this paper, the current Triple Helix paradigm is riddled with shortcomings which makes it an ineffective option for Science and its relationship with developing world. The structural limitations of the current model elucidate that the 'Triple Helix Model' is indeed is one for the twentieth century and not for the incredibly fluid networked 21st century world, which is enveloping us. There are many private sector organizations and nonprofit organizations which steer the developmental discourse than old school nation states as the role of the United Nations in influencing the narrative dwindles. The model, which we prescribe in this paper deals with the multipronged epistemological character of science and the knowledge which is produced has rooted in a 'local' context for it to be embedded in society. Science like any other social institution is influenced by power dynamics, and even more when it is to be utilized in a developmental mold. This ‘fact’ is genuinely missing from the existing Triple Helix conversation. We assume that various actors in the space will all self-configure to attain maximum leverage for development. This is indeed a fallacy as every actor is a product of their unique mix of capitals (economic, political, and social). The Post Triple Helix Model is a framework accounting in all these variables, a framework which sets the stage for the next level of the application of science of developmental purposes. The extended framework prescribed in this paper can be used as a model for meeting the United Nations Millennium Development Goals.

Reference

Bloor, David (1976) *Knowledge and social imagery*. London: Routledge.

Bijker, Wiebe E., Thomas P. Hughes, and Trevor J. Pinch, eds. The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology. Cambridge, MA: MIT Press, 1987.

Bourdieu, Pierre (1977) Outline of a Theory of Practice. Cambridge University Press.

Bourdieu, P. (1986) The forms of capital. In J. Richardson (Ed.) Handbook of Theory and Research for the Sociology of Education (New York, Greenwood), 241-258.

Ezkowitz Henry. The Triple Helix:University-Industry-Government Innovation in Action. Routledge.2008.

Hess, David J. (1997). Science Studies: An Advanced Introduction. New York: New York University Press.

Kuhn, T.S. (1970), *The Structure of Scientific Revolutions*, 2nd ed., Chicago: University of Chicago Press.

Merton, R.K. (1973), *The Sociology of Science*, Chicago: University of Chicago Press. (Especially 'The Normative Structure of Science'.)

Mohammed Saad and Girma Zawdie. *Theory and the Practice of Triple Helix in Developing Countries.* Routledge. 2011.

Phadke Roopali. “People’s Science in Action: The Politics of Protest and Knowledge Brokering in India”. Society and Natural Resources 18 (2005): 363-375

Sheridan, Alan (1980*), Michel Foucault -The Will to Truth:* Routledge.

Viale Riccardo and Ezkowitz Henry. The Capitalization of Knowledge: A Triple Helix of University–Industry–Government. Edward Elger Publishing Limited. (2010)

Whitley Richard (1972) “Black Boxism and the Sociology of Science: A Discussion of the Major Developments in the Field.” *Sociological Review Monograph: The Sociology of Science* 18:61-92.Keele: University of Keele.

Winner Langdon (1979) “The Political Philosophy of Alternative Technology: Historical Roots and Present Prospects”. *Technology in Society*, Vol. 1, pp. 75-86

Winner Langdon, “Do Artefacts Have Politics?” *The Whale and the Reactor: a Search for Limits in an age of High Technology* (Chicago: University of Chicago Press, 1986), pp. 19-39.

Winner Langdon (1977) *Autonomous Technology: Technics-out-of-Control as a Theme in Political Thought*, M.I.T. Press.

CALLING FOR ABG (ACADEMIC –BUSINESS –GOVERNMENT) LEADERSHIP EARLY IDENTIFICATION OF EFFECTIVE CHARACTERISTICS OF LEADERSHIP TO SUPPORT TRIPLE HELIX MODEL

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Abstract
The important role of a leader to the success of an organization is unquestionable. Research in leadership has successfully provided many theories about leaders and the organizations they lead. The Triple Helix concept and academia/business/government interconnection can spur the innovative capacities and capabilities of developing countries. Indonesia as a developing country is calling for leaders with set characters that can boost economic development. Based on the Triple Helix Concept there are two questions that should be addressed.. First is “How each sector perceive success leaders in academia-business -government” (value side) , and what makes those leaders successfull (characteristics side) . The second questions is “Are there any common characteristics and distinguishing characteristics among those sectors?”. The academic sector, the business sector and the government sector are the sources of leaders to the society . It is recognized that the growth of a country is affected by a policy covering three inter-related sectors of the sector / academic environment, the sector / business environment and sector / government environment. It is also very clear that there has been intensive mobility among leaders in those sectors. There is a phenomena that each sector may provide different leadership characters and behavior.

This research is conducted as an early identification of indicators that are considered successful leaders by the constituents (members) and to discover the common factors and distinguishing factors among the three sectors. Research is carried out by conducting exclusive interviews by more than 400 undergraduate students in School of Business and Management from years 2005 to 2010 with more than 400 leaders who were "role models" of the interviewers. The interviewer as field researchers attempted to find "value as role models", and identified "individual behavior-character" which are believed to be the key to successful leader in those three sector. Further research was done using the 400 role models to provide identification of the "values that are considered important" as effective leaders in all three sectors and obtain effective behavioral traits that support success in each sector. The research identified the sets of the perceived reason to be a role model , the identification of effective leadership characteristics in three sectors, the common characteristics and the distinguishing characteristics among those three.

COLLABORATION AND TRUST BUILDING AMONG STAKEHOLDERS IN CITARUM RIVER BASIN CONFLICT

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Abstract
This research proposes an agent-based model of conflicts, collaboration and trust among in Citarum river basin conflict. A conflict is unavoidable in daily life. Negotiation as an effort to resolve conflict is a very common process in everyday life. This is why negotiation process is studied in many scientific fields such as economy, political science, psychology, organizational behavior, decision sciences, operations research and mathematics (Sycara & Dai, 2010). This paper discusses steps in the model construction, model validation, and inferring policy using this agent-based model. Citarum River is the longest river in West Java province (Balai PSDA Wilayah Sungai Citarum, 2004). Many people depend on the Citarum River, making it one of the most strategic river in Indonesia (Puslitbang Sumber Daya Air, 2005). Unfortunately, Its condition now has changed completely (Sungkono, 2005). Since the industrialization in the 80s, It was turned into industrial landfills. Approximately there are 500 textile factories that dispose their waste into Citarum River without appropriate waste treatment. Its condition is worsened by the population explosion in the upstream area that also increased the number of illegal logging and disposal of household waste (Pemerintah Propinsi Jawa Barat, 2002). Flood always occurs during the rainy season due to sedimentation in downstream areas and increasing number of barren land. Citarum River Basin conflict involves at least 33 stake holders that have conflicting interest. Because of this, efforts to restore the condition of Citarum River become useless.

Keywords: agent based simulation, drama theory, dilemma, collaboration, trust building

1. Introduction

1.1 Background

Social phenomena involve people which may act based on their own interests and interactive situations, in which parties are related and interdependent. In such situation, result gained by a party depends on the action from other parties. Therefore, human interaction always involves conflict and collaboration (Obeidi, Kilgour, & Hipel, 2009). As an effect, negotiation to resolve a conflict is a very common process in daily life and studied in various scientific areas (Sycara & Dai, 2010). Many existings negotiation models generally assume negotiation as simple interactions, well structured and as a onetime event (Sycara & Dai, 2010), while in reality negotiation is a reciprocal interaction between parties. Negotiation in the real world (except in the simplest form) has the followings characteristics *i.e.*: (1) Decentralized (Sycara & Dai, 2010), parties in a negotiation can have different frames and strategies in seeking resolution of conflict; (2) Parties' decisions are interlinked through communication processes that involve many different levels (Koeszegi & Vetschera, 2010; Sycara & Dai, 2010); (3) Involve incomplete information (Sycara & Dai, 2010); (4) Involves repeated interaction with no well-structured sequences (Sycara & Dai, 2010); (5) Involves emotions as a device in structuring goals, values and preferences (Martinovski, 2010) and affects communication (Koeszegi & Vetschera, 2010) in a negotiation.

Through the above review, there are gaps between current negotiation models and the situations in the real world. Computer simulation is one of the alternative approaches to fill the gap that currently occurs. There are several natures of a computer simulation that can help researchers to model a conflict, *i.e.* (1) The nature of programming language that is more expressive than verbal language and less abstract than mathematical equation (Srbljinović & Škunca, 2003), enable researcher to model both quantitative and qualitative theories (Gilbert & Terna, 2000); (2) Using computer simulation it is easier to model decentralized processes that involve bounded rational agents (Srbljinović & Škunca, 2003); (3) Within a computer simulation there are no difficulties to model repeated interaction with no well-structured sequences.

1.2 Objective

This study aims to construct an agent-based model (ABM) of the dynamics of negotiation based on drama theory (DT) that includes emotions and learning. The ABM is considered to be appropriate because it can fully represents individuals and model bounded rational behavior while, DT is chosen because it proposes an episodic model whereby situations unfold. Using this model it is expected that the possible evolution of the conflict can be observed and suggestions to agents in the real world in order to achieve the desired futures can be proposed.

This research is a development of previous studies regarding ABM of conflict that involves emotion and learning that has been carried out since 2007 (Putro, Siallagan, & Novani, 2007; Putro U. , Siallagan, Novani, & Utomo, 2008; Putro, Hermawan, Siallagan, Novani, & Utomo, 2010; Hermawan, Putro, Alamanda, & Utomo, 2011; Utomo, Hermawan, & Putro, 2011). These researches produce an ABM of conflict based on DT that incorporates agent's emotions, learning ability and misperceptions among agents. The focus of this paper is to discuss the research steps undertaken to construct this ABM, the suitability of the model to describe the conflict evolution in the selected case and, finally the potencial application of the model as a table top exercise to enhance collaboration and trust among stakeholders, especially in Citarum river Basin Conflict case.

1.3 Case Citarum River Basin Conflict

Citarum River basin is a region in Java Island, Indonesia, with 6,080 km^2 area crossing West Java, Banten, and Jakarta. The upstream located in Wayang Mountain, in south Bandung and the downstream is located in Karawang, and flows through ten regencies and cities (Balai PSDA Wilayah Sungai Citarum, 2004) with total length of 225 km. Citarum is one of the strategic rivers in Indonesia that generates 1,350 MW of electric power, irrigates 240,000 ha of rice fields, provides 45.75 billion cubic of water for industry, 43.3 billion m^3 of water for fisheries, and 400.5 billion m^3 of water for domestic purposes (Puslitbang Sumber Daya Air, 2005). In addition, Citarum also became the recreation object for the community.In the past Citarum can perform these functions well, but those conditions now have changed completely (Sungkono, 2005). Floods always occur during the rainy season because of sedimentation and the increasing number of barren land (Umar, 2005). This condition has caused many kinds of diseases suffered by people along Citarum. Citarum even takes seventh position of the ten dirtiest rivers in the world, in 2010 (Tribun, 2010).

There are several causes of the condition. First is the population explosion in the upper stream region (Maulana, 2003) that led to an increase in illegal lodging and deforestation. Second is the disposal of household waste into the river. Along the river there are ± 8 million residents who produce (Pemerintah Propinsi Jawa Barat, 2002) at least 200 tons of household wastes that are thrown away into Citarum. Along the Citarum river there are 1000 industries that use surface water, as well as producing industrial waste (Pemerintah Propinsi Jawa Barat, 2002) many of which are thrown into the river without proper treatment.

The problem in Citarum River basin involves hundreds of agents. Through literature studies conducted on mass media, reports and previous studies groups of agents that play significant role in the conflict from 2007 until now can be classified as follows:

- **Business Sector (BS):** Group of private business *e.g.* real estate entrepreneurs, factory outlets and textile industries. They use the area as their business establishment and become user of surface water but unfortunately, sometimes they violate the established provisions and dispose their waste in to the river.
- **Community (COM):** Groups of community *e.g.* farmer, woodlander, merchant alliance, etc. They need the land in Citarum River Basin for housing and agriculture, and the water for irrigation and domestic usage but, sometimes they are also dumping their household waste into the river. Because they lived close to the Citarum River this group also become the main victims of flood and contamination that occurred in the Citarum River.
- **Government (GOV):** Group of government agencies *e.g.* central government, provincial government, city agencies / counties agencies. The interest of this group members are to prevent floods in the area, to preserve nature in the Citarum River Basin, to maintain the availability of water supplies, to improve the welfare of the people in the Citarum river basin and to earn regional revenue.
- **NGO:** Group of nonprofit institutions *e.g.* professionals, community leaders, environmentalist, academicians and

humanist. They are eager to prevent floods in the area, to preserve the nature in the Citarum River Basin, and to improve COM welfare and health.

- **Public Enterprise (PE):** Group of State owned and regional owned enterprises that are responsible to serve the public and to gain profit for the company *e.g.* PDAM (Regional Drinking Water Company), PJT (National Dringking Water Company), Indonesia Power (electricity company), etc. The decline in water quality and sedimentation of the river diminish their ability to serve COM and making profit.

There are many programs and proposals that have been produced through the interaction and negotiation among these agents. However, conflicting interests among agents hamper the conflict resolution, and make Citarum River conditions worsen.

2. Research Methodology

This study begins with literature review, which aims to identify the latest developments of the Citarum river basin conflict, concepts relating to DT, ABM and the PAD model, the result are new important information about the Citarum river basin conflict and the limitations in the previous simulation. The second step of this research is to conduct field observations and focus group discussion (FGD) with all stake holders, to obtain a description of the current condition of Citarum river basin conflict. Based on the obtained data, common reference frames (CRF) of Citarum river basin conflict were constructed. These CRFs describe the historical dynamics of Citarum river basin conflict. To test model's robustness to the dynamics of agent's alignment and the emergence of new options the CRFs are captured at two different milestones (resulting two scenarios). Each scenario consists of two CRF that is the CRF before the milestone and the CRF after the milestone. By using two CRFs for each scenario, agent's efforts to reduce the dilemmas and their emotion within the period can be identified. The first CRF describes the positions taken by each agent before 2008 shown in Table 1 (left). Prior to 2008 GOV was reluctant to cooperate with NGOs and PE to preserve the Citarum River Basin. However, after 2008, especially after the implementation of Integrated Water Resource Management (IWRM), GOV became more open and inviting COM, NGOs and PE to participate in efforts to preserve the Citarum River Basin. Therefore after 2008 GOV is adopting their giving more authorities option while, COM abandon their protest option.

Since the decision to contribute to the preservation of the Citarum River now lies in the hands of PEs this option is no longer relevant for GOV after 2008, therefore two new options are defined for PE *i.e.* to conduct reforestation and to regulate waste disposal. Based on observation, literature study and FGD, positions taken by each agent before 2009 (second scenario) can be described by the common reference in Table 2. Table 2 shows that after 2009 COM is adopting their protest options and also hopes that NGOs are supporting them. COM also becomes more participative in PEs reforestation efforts. GOV become more aware to maintain the downstream river and to give sanction to BS that violates regulations. NGOs are also become more active in criticize GOV and BS.

Table 1. CRF of Citarum River Basin Conflict before and after 2008

	Before 2008						After 2008					
		Agent's Position						Agent's Position				
Agent's Option	Threat	BS	C	G	NGO	PE	Threat	BS	C	G	NGO	PE
Business Sector		>>	>>	>>	>>	>>		>>	>>	>>	>>	>>
Stop damaging drainage	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Stop polluting Citarum	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Community		<<		>>	>>	>>		<<		>>	>>	>>
Protest	Yes	No	Yes	No	Yes/No	Yes/No	Yes	No	No	No	Yes/No	No
Stop illegal logging	No	No	No	No	Yes	Yes	No	No	No	No	Yes	Yes
Stop waste disposal to river	No	Yes/No	No	Yes	Yes	Yes	No	Yes/No	No	Yes	Yes	Yes
Government		<<	>>		>>	>>		<<	>>		>>	>>
Maintenance down stream river	No	No	Yes	No	Yes	Yes	No	No	Yes	No	Yes	Yes
Give sanction to people	No	No	No	No	Yes	Yes	No	Yes	No	No	Yes	Yes
Give sanction to business sector	No	No	Yes	No	Yes	Yes	No	No	Yes	No	Yes	Yes
Give real estate lisence	Yes	No	No	Yes	No	No	Yes	Yes	No	Yes	No	No
Giving more authorities for public enterprises	No	Yes/No	Yes/No	No	Yes	Yes	No	Yes/No	Yes/No	Yes	Yes	Yes
NGO		<<	<<	<<		<<		<<	<<	<<		<<
Protest	Yes	No	Yes	No	No	No	Yes	No	Yes	No	No	No
Public Enterprise		<<	>>	>>	>>			<<	>>	>>	>>	
Pro active for agency sustainability	No	Yes/No	Yes/No	Yes/No	Yes	Yes	No	Yes/No	Yes/No	Yes	Yes	Yes

Table 2. CRF of Citarum River Basin Conflict before and after 2009

	Before 2009						After 2009					
		Positions						Positions				
Agent's Option	Threat	BS	C	G	NGO	PE	Threat	BS	C	G	NGO	PE
Business Sector			>>	>>	>>	>>			>>	>>	>>	>>
Stop damaging drainage	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Stop polluting Citarum	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Community		<<		>>	>>	>>		<<		>>	>>	>>
Protest	Yes	No	No	No	Yes/No	No	Yes	No	Yes	No	Yes	No
Stop illegal logging	No	No	No	No	Yes	Yes	No	No	No	Yes	Yes	Yes
Stop waste disposal to river	No	Yes/No	No	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes
Government		<<	>>		>>	>>		<<	>>		>>	>>
Maintenance down stream river	No	No	Yes	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Give sanction to people	No	Yes	No	No	Yes	Yes	No	Yes	No	No	Yes	Yes
Give sanction to business sector	No	No	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Give real estate lisence	Yes	Yes	No	Yes	No	No	Yes	No	No	Yes	No	No
NGO		<<	<<	<<		<<		<<	<<	<<		<<
Protest	Yes	No	Yes	No	No	Yes	Yes	No	Yes	No	Yes	Yes
Public Enterprise		<<	>>	>>	>>			<<	>>	>>	>>	
Regulate the waste disposal	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
Reforestation	No	No	Yes/No	Yes	Yes	Yes	No	No	Yes/No	Yes	Yes	Yes

The next stage is to construct the ABM, begin by defining agents and its attributes (Gilbert N. , 2004) such as agent's positions, emotions and payoffs. In this study, the agents and their attributes are defined based on the result of the field observation and FGD. After that, the interaction mechanisms among agents are deductively constructed (Gilbert & Terna, 2000). The interaction mechanisms consist of several modules i.e., payoff module, negotiation protocol module, emotional dynamic module, and learning module.

The next stage is to conduct verification of the simulation. Verification process is intended to test the internal consistency of the simulation mechanism (Gilbert N. , 2004). In this process test are conducted to evaluate whether the behavior shown by the simulation is purely caused by the constructed mechanism and not caused by programming errors/bugs. To avoid bugs in the model, unit testing, add assertion and corner testing technique are used. In unit testing technique, the model is divided into several units. A series of input for each unit is then supplied; the unit's outputs are then compared to the expected output of the given unit (Ramanath & Gilbert, 2004). Usually, the expected output can be calculated manually. In add assertion, warning codes are attached to variables that have specific range of values in order to prevent the value of the variable from running out of range (Ramanath & Gilbert, 2004). In corner testing technique, the model is tested whether it can produce reasonable outputs at extremes scenarios or not (Ramanath & Gilbert, 2004).

After the simulation is verified, the next stage is to conduct virtual experiments. The virtual experiments in this study consist of two parts. The first part of the experiment aims to test the feasibility of the model's predictions. In this process the model is tested whether its outputs can show qualitative or quantitative agreement with empirical macro structure in the real world (Gilbert N. , 2004) or not. The third part of the experiment aim to explore patterns that can be generated by the model. Based on these patterns, possible suggestions in order to achieve resolution in Citarum river basin conflict are inferred. These suggestions can take form of policy recommendations or identification of types of agent's behavior that support collaboration.

3. Experiment

3.1 Testing the feasibility of proposed model to describe the dynamics of agent's emotion

The purpose these experiments are to test the feasibility of the model in describing the dynamics of agent's emotion. Experiments in this section are divided in two scenarios. In the first scenario the CRFs is initiated according to the CRF before 2008 and in the second scenario the CRF is initiated according to the CRF before 2009. In all experiment, agent's payoffs and emotional dimensions are initiated randomly. In each experiment the trends of emotional dynamics are observed. Trends of emotional dynamics are characterized by the average of agent *i*'s pleasure, arousal and dominance toward all other agents. The trend is then compared to the trend of agent's emotion in the real world as in the case study. Using indicators in the case study, the model can be considered as feasible in describing the dynamics of agent's emotion if there is at last one of the simulation result that has an interval in which agent's emotion trends are similar to the agent's emotion trends in the real world.

Based on the field study and FGD in the period before 2008 and after 2008 there are changes in agent's emotion with trends that are described in Fig 1(a). Although the behaviors that are demonstrated by the model vary from one experiment to another experiment, there are some simulation results that can mimic criteria in the above table. Example of simulation result that fulfills the above criteria is illustrated in Fig 1(b). Between 7th iteration and 12th iteration has emotional trends that are similar to the criteria in Fig 1(a).

(a) Real world agent's emotion in scenario 1

	Pleasure	Arousal	Dominance
Community	Decrease	Increase	Decrease
Government	Increase	decrease	Decrease
Public Enterprise	Increase	Increase	Increase

(b) Agent's emotional trends based on experiment

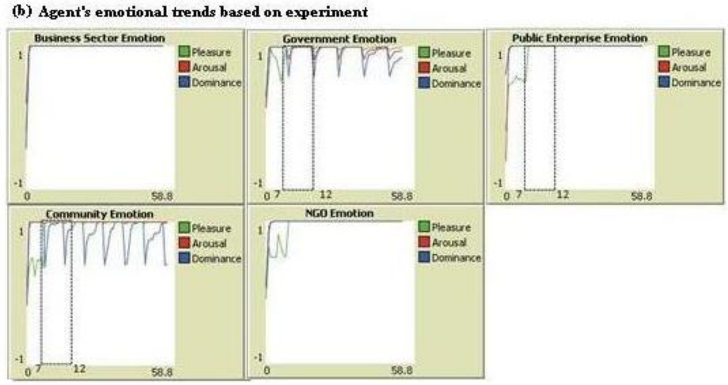


Fig. 1. (a) Real world agent's emotion trends output in scenario 1; (b) Agent's emotional trends based on experiment

Based on the field study and FGD, during before 2009 to after 2009 there are changes in agent's emotion with trends that are described in Fig 2(a). Example of simulation result that fulfills the above criteria in Fig 2(a) is illustrated in Fig 2(b). Between 8th iteration and 10th iteration has emotional trends that are almost similar with the criteria in Fig 2(a).

By considering the simulation results in this section, it can be concluded that although agent's emotional dimensions and a payoff are initiated randomly the model is feasible to describe possible emotional trends among agents. The model can generate output that mimics the trend of agent's emotion in the real world either when agent's positions are initiated based on the CRFs before 2008 as well as when the agent's positions are initiated based on the CRF before 2009.

(a) Real world agent's emotion in scenario 2

	Pleasure	Arousal	Dominance
Business Sector	Decrease	decrease	Increase
Community	Decrease	Increase	Decrease
Government	Increase	Increase	Increase
NGO	Increase	Increase	Increase
Public Enterprise	Increase	Increase	Increase

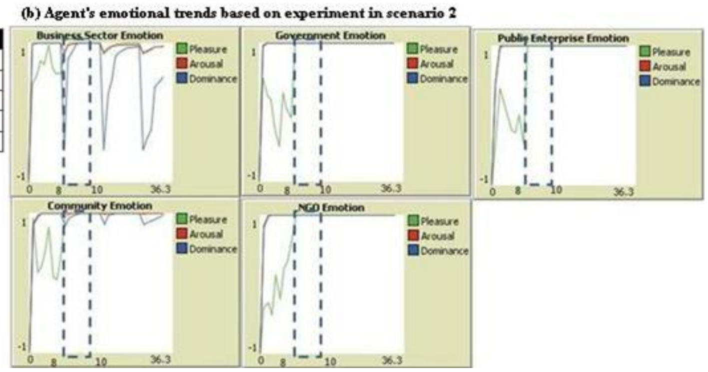


Fig. 2. (a) Real world agent's emotion trends output in scenario 2; (b) Agent's emotional trends based on experiment

3.2 Testing the feasibility of proposed model to describe the dynamics of agent's positions

This section discusses experiments that are carried out to test whether the model is feasible in describing the dynamics of agent's positions as a result of the negotiation process. The experiments in this section are divided in two scenarios. In the first scenario the CRFs is initiated according to the CRF before 2008 and in the second scenario the CRF is initiated according to the CRF before 2009. In each experiment, agent's payoffs and emotional dimensions are initiated randomly.

Because there are some parts of the model that have random nature, the probability of occurrence of configuration that is exactly similar to the CRF in the real world is very small. Therefore in this study the model is considered as feasible in describing the dynamics of agent's positions if it can mimic the majority of agent's position for a certain option. The CRFs after 2008 and after 2009 are set as the target condition that should be mimicked by the model. Based on the case study the position of the majority of agent's positions for each option after 2008 are described in Fig 3(a). Although the behaviors that are demonstrated by the model vary from one experiment to another experiment, there are some simulation results that can mimic criteria in the above table. Example of simulation result that mimics the criteria in Fig 3(a) is illustrated in Fig 3(b).

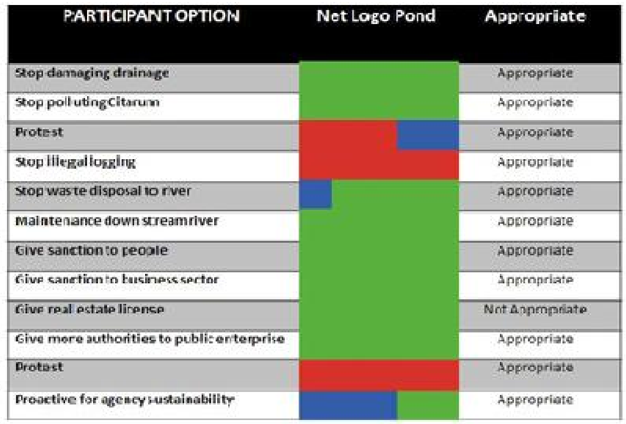
In Fig 3(b), the first column shows the options owned by each agent, the second column shows the preview of the simulation result in NetLogo simulation and the third column shows the feasibility of the model in describing the majority of agent's positions for each option. In the third column, appropriate label is given if the majority of agent's position predicted by the model is similar to the majority of agent's position in the real world. The above figure shows that from twelve options in the common reference after 2008, the model can predict the majority of agent's position of eleven options appropriately.

Based on the case study the position of the majority of agent's positions for each option after 2009 are shown in Fig 4 (a). Example of simulation result that fulfills the above criteria is illustrated in Fig 4 (b). Fig 4 (b) shows that from twelve options in the common reference after 2009, the model can predict the majority of agent's position of ten options appropriately. Although the model's accuracy in predicting agent's majority positions that will emerge is not perfect however, the model is quite feasible in describing dynamics of changes in agent's position that may occur during the negotiation process.

In the first scenario the model can describe the changing in the majority of agent's position regarding the give sanction to people option. Before 2008 the majority of agents reject this option but, after 2008 the majority of agents accept this option. In addition, the model can describe a changing in the majority of agent's position regarding the proactive for agency sustainability option. Before 2008 the majority of agents are indifferent towards this option, but, after 2008 the majority of agents accept this option. In the second scenario, the model can describe a changing in the majority of agent's position regarding the protest the options owned by the NGO. Before 2009, the majority of the agents reject this option but, after 2009 the majority of the agents accept this option.

PARTICIPANT OPTION	Majority Position
Stop damaging drainage	Yes
Stop polluting Citarum	Yes
Protest	No
Stop illegal logging	No
Stop waste disposal to river	Yes
Maintenance down stream river	Yes
Give sanction to people	Yes
Give sanction to business sector	Yes
Give real estate license	No
Give more authorities to public enterprise	Yes
Protest	No
Proactive for agency sustainability	Yes

(a)

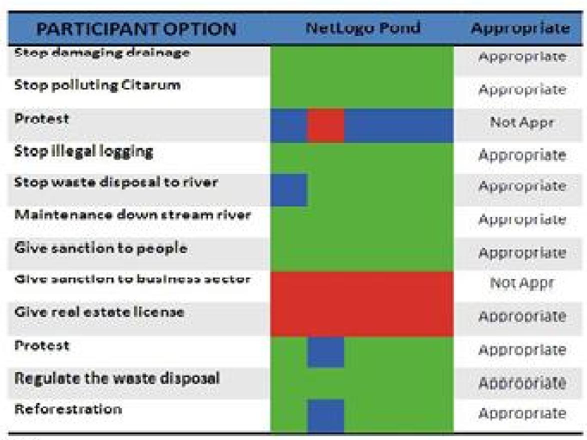


(b)

Fig. 3. (a) Real world agent'majority position in scenario 1; (b) Agent's majority position based on the simulation

PARTICIPANT OPTION	Majority Position
Stop damaging drainage	Yes
Stop polluting Citarum	Yes
Protest	No
Stop illegal logging	Yes
Stop waste disposal to river	Yes
Maintenance down stream river	Yes
Give sanction to people	Yes
Give sanction to business sector	Yes
Give real estate license	No
Protest	Yes
Regulate the waste disposal	Yes
Reforestration	Yes

(a)



(b)

Fig. 4. (a) Real world agent'majority position in scenario 2; (b) Agent's majority position based on the simulation

4. Potential Application

Traditional scientific language can be divided in two form, natural language and mathematical language. Natural language can be easily understood and studied, but it is ambiguous. On the other hand, mathematical language is more structured, it is not ambiguous but it is more difficult to learn and to be used. Social Simulation can be considered as the tertiary language. Especially in the area of social sciences and humanities, we need a bounded rational, inter-subjective and participatory way to construct knowledge of the world. An agent based modeling and simulation enable us to construct bottom-up models for social and organizational systems using macro functional and simple requirement. A social simulation dose not gives a universal natural law. However it helps us to construct a shared social reality or internal model (Deguchi, 2012).

One potential application of ABM is to perform a Table Top Exercise or guide a FGD. A table top exercise is an exercise that is designed to test the theoretical ability of a group to respond to a situation. Simulation supported table top exercise or FGD are very effective communication tools. Simulated table top exercise provides better shared inter-subjective internal model of the real world than implicit models in decision maker's brain. The simulation is not always must able to predict the outcomes of scenarios but can help to clarify and evaluate possible options of scenarios (Deguchi, 2012).

ABM in this study for example, can provide insight to decision makers regarding the potential evolution of the conflict that may occur due to the action and reaction of each agent. Scenario that can be tested through this simulation, for example, what might happen if the trends of each agent emotions tend to be negative? This can be interpreted in the real world in form of demonstration conducted by COM, the repressive actions from GOV or BS to the people who conduct demonstrations, and the reluctance of industry to comply with GOV regulations. By using the CRF in 2009 as the initial condition, the simulation results show that this scenario will not be able to improve the condition of the Citarum River, as shown by Fig 5.

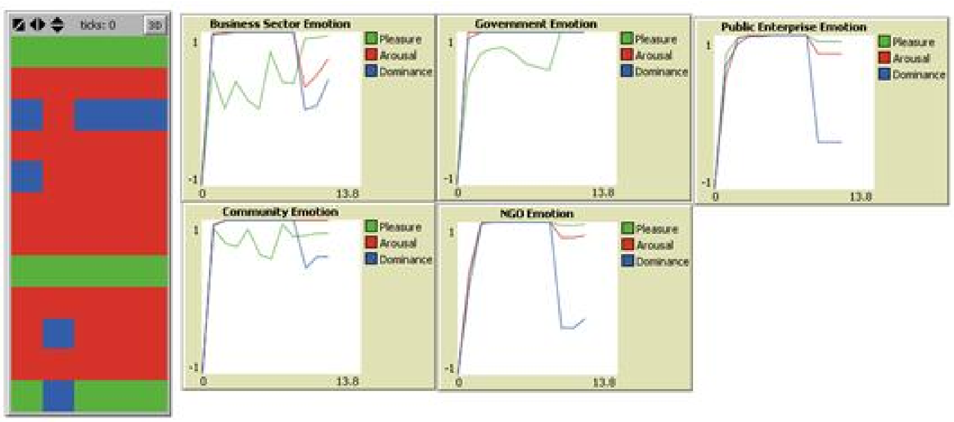


Fig. 5. Simulation result that produce undesired resolution

Another scenario that can be tested through this simulation, for example, what might happen if the trends of each agent emotions tend to be positive? This can be interpreted in the real world in form of compromise, and the willingness of industry to comply with GOV regulations. By using the CRF in 2009 as the initial condition, the simulation results show that this scenario will potentially able to improve the condition of the Citarum River, as shown by Fig 6.

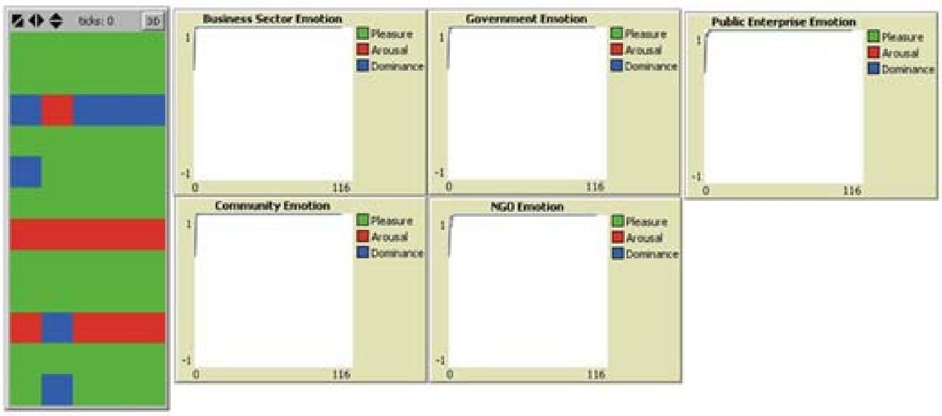


Fig. 6. The simulation result that produce desired resolution in Citarum River Basin conflict

In this potential future condition all agents agree that:

- BSs are no longer damage the city drainage and no longer dispose of waste into the river Citarum.
- COM stops illegal logging activity and no longer throws household waste into the Citarum River.
- GOV maintain downstream river and no longer permit real estate construction.
- PEs help to regulate waste disposal and to do Reforestation.

Of course there are still many combinations of scenarios that can be explored through this simulation, and each scenario will lead to a different future condition. This simulation can also be calibrated to analyze the evolution of other conflicts. This can be done by conducting FGDs with stakeholders to obtain their views on the conflict situation and making explicit the option, the position and the threat of all agents based on their perception. Therefore social simulation functions for combining fragments of knowledge and to supports better communication in order to construct common understanding among stakeholders in a problem can be carried out.

5. Conclusions and Further Research

In this research an ABM of dynamics of confrontation that involves emotion and learning has been constructed. By comparing the trend of agent's emotion generated by the simulation in the first experiment and the trend of agent's emotion obtained through FGD, it can be concluded that there are results of simulations that can mimic the trend of agent's emotion in the real world. The model will produces a number of trends of agent's emotion that may arise in the real world. These trends can help stakeholders to anticipate the escalation of the conflict. Of course for this purpose the model needs to be calibrated with actual emotional state of each agent. The feasibility of the model to describe the trend of agent's emotion is robust against initial CRF. This means that the model is also feasible to describe the trend of agent's emotion that may appear in other conflict situation. By comparing the CRF generated by the model in the second esperiment with the CRFs obtained through FGD it can be concluded that there are results of the simulation which can resemble the majority of agent's positions the real world (although the results are not 100% accurate). The model will produces a number of CRF that may arise in the real world. These CRFs can assist stakeholders to anticipate the final majority of agents' positions that may occur as the result of the conflict. The feasibility of the model to describe the majority of agent's positions is robust against initial CRF. This means that the model is also feasible to describe the majority of agent's position that may appear in other conflict situation. The model in this study can provide insight to stakeholders regarding the potential evolution of the conflict that may occur due to the action and reaction of each agent. Using table top exercise or FGD, the model can help to test possible scenarios and alternatives.

The model in this study still has some weaknesses. In the model it is assumed, that an agent is a coalition of a number of actors in the real world. Members of each coalition are considered fixed and not changed during the course of the conflict. Through the qualitative study conducted in this study, it is identified that the members within each coalition can change with durig the course of the conflict. To develop this model further it is important to consider the process regarding the formation mechanism and the dynamics of agent's coalition.

In the DT model there are six drama dilemmas that can arise in a conflict. This model only accommodates three dilemmas among those six dilemmas. This model can be developed further by also model the positioning, threat and cooperation dilemma.

In experiments conducted with the model a number of inputs such as agent's payoff and the agent's emotion are initialized randomly. In order to utilize this model further to assist agents in the real world in anticipating the dynamics of conflict that may occur, instruments that can help to identify the value of these variables need to be constructed.

References

Albin, C., & Druckman, D. (2010). The Role of Justice in Negotiation. In D. Kilgour, & C. Eden, *Advances in Group Decision and Negotiation 4 : Handbook of Group Decision and Negotiation* (pp. 109-120). New York: Springer.

Balai PSDA Wilayah Sungai Citarum. (2004). *Laporan Akhir Tahun 2004.*

Deguchi, H. (2012). Introduction to Agent Based Modeling. *The International Workshop on Agent-based Modeling and Simulation for Policy Development.* Jakarta.

Gilbert, N. (2004, December 18). *Agent-based Social Simulation: Dealing with Complexity.* Retrieved October 26, 2008, from http://www.agsm.unsw.eduau/bobm/teaching/SimSS/ABSSdealingwithcomplexity-1-1.pdf

Gilbert, N., & Terna, P. (2000). *How to Build and Use Agent-based Models in Social Science.* Retrieved March 3, 2008, from Facoltà di Economia Torino: http://web.econ.unito.it/terna/deposito/gil_ter.pdf

Hermawan, P., Putro, U. S., Alamanda, D. T., & Utomo, D. S. (2011). Environmental Management Using Drama Theory Case Study: Citarum River Basin Conflict, West Java, Indonesia. *Proceedings 2011 World Congress on Engineering and Technology* (pp. 694-697). Shanghai, China: IEEE Press.

Koeszegi, S. T., & Vetschera, R. (2010). Analysis of Negotiataion Process. In D. M. Kilgour, & C. Eden, *Advances in Group Decision and Negotiation 4 : Handbook of Group Decision and Negotiation* (pp. 121-138). New York: Springer.

Martinovski, B. (2010). Emotion in Negotiation. In D. M. Kilgour, & C. Eden, *in Advances in Group Decision and Negotiation 4 : Handbook of Group Decision and Negotiation* (pp. 65-86). New York: Springer.

Maulana, F. (2003, May 12). Menyelamatkan Hutan Tatar Sunda. *Kompas Online* .

Obeidi, A., Kilgour, D. M., & Hipel, K. W. (2009). Perceptual Graph Model Systems. *Group Decision and Negotiation* .

Pemerintah Propinsi Jawa Barat. (2002). *Kerangka Acuan Pola Induk Program Citarum Bergetar*. Bandung.

Puslitbang Sumber Daya Air. (2005). *Katalog Sungai di Indonesia* (Vol. 1).

Putro, U., Hermawan, P., Siallagan, M., Novani, S., & Utomo, D. (2010). Agent-Based Simulation of Negotiation Process in Citarum River Basin Conflict. *Proceedings PAN-PACIFIC Conference XXVII May31 – June 2 2010*, (pp. 63-65). Bali.

Putro, U., Siallagan, M., & Novani, S. (2007). Agen based simulation of negotiation process using drama theory. *Proceedings of the 51st Annual Meeting of the International Society for the Systems Sciences.* Tokyo.

Putro, U., Siallagan, M., Novani, S., & Utomo, D. (2008). Managing Collaboration Using Agent Based Simulation. *Proceedings PRIMA*, (pp. 348-356). Hanoi.

Ramanath, A., & Gilbert, N. (2004). Tehcniques for the Construction and Evaluation of Participatory Simulations. *Journal of Artificial Societies and Social Simulation , 7* (4), 1.

Srbljinović, A., & Škunca, O. (2003). An Introduction to Agent Based Modelling and Simulation of Social Process. *Interdisciplinary Description of Complex Systems , 1*, 1-8.

Sungkono, E. (2005, April 17). Citarum. *Pikiran Rakyat* .

Sycara, K., & Dai, T. (2010). Agent Reasoning in Negotiation. In D. Kilgour, & C. Eden, *Advances in Group Decision and Negotiation 4 : Handbook of Group Decision and Negotiation* (pp. 437-451). New York: Springer.

Tribun. (2010, September 2). *Aduh... Citarum Sungai Terkotor di Dunia*. Retrieved July 18, 2011, from Tribunnews.com: http://www.tribunnews.com/2010/09/02/aduh...-citarum-sungai-terkotor-di-dunia

Umar, S. (2005, March 25). Meminimalisasi Banjir Citarum. *Pikiran Rakyat* .

Utomo, D. S., Hermawan, P., & Putro, U. S. (2011). How Can Agent Learn Other Agent's Emotion in Dynamic Negotiation Process? *Proceedings 2011 World Congress on Engineering and Technology* (pp. 73-76). Shanghai, China: IEEE Press.

H. Triple Helix Model for Government Institution

DEVELOPING STRATEGIC INITIATIVES THROUGH TRIPLE HELIX INTERACTIONS: SYSTEMS MODELLING FOR POLICY DEVELOPMENT

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Abstract
Public policy problems are socially complex due to a range of stakeholders who involve in the coordinated action. They are also often not stable due to situation changes or stakeholders' behavior changes. Holistic thinking is actually required to solve a public policy problem, which is generally non-linear and highly complicated, through collaborative efforts across organizational boundaries. The approach of systems modelling offers an option for formulating and rehearsing strategic initiatives to resolve the problems in a systematic, structured and accountable. This paper presents an innovative effort to implement a triple helix model for supporting the development of national policies using systems modelling approaches initiated by the President's Delivery Unit for Development Monitoring and Oversight (UKP-PPP) of Republic Indonesia and the School of Business and Management, Institut Teknologi Bandung (ITB). Series of workshops have been initiated to facilitate communication and cooperation among researchers in academic institutions, practitioners in industry and business, and decision makers in government. Analyzing this finding and interactions that occurred among stakeholders during the workshops, a model of Triple Helix interactions is formulated. In addition to known interaction between university and industry, interaction between university and government on policy development through the channel of state-owned research and development agencies was identified. Not only promoting systems modelling as a methodology in policy development, the workshops also provided evidence on the importance of having a holistic or systemic approach in formulating policies to address a complex national problem that requires interactions among stakeholders.

Keywords: systems modelling, policy development, triple helix

IMPLEMENTING THE TRIPLE HELIX MODEL TO EXPAND THE ECONOMY OF GORONTALO PROVINCE BEYOND NATURAL GROWTH AND CREATE A WELFARE PROVINCE FOR ALL

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Abstract
The young province of Gorontalo currently has a relatively inferior economic profile, its GDP ranked 30 out of 33 Indonesian Provinces. Gorontalo's local government (PEMDA) faces significant challenges to increase the economic volume of Gorontalo province. Under Indonesia's central government development strategy "Acceleration and Expansion of Indonesia Economic Development 2011-2025" (MP3EI), Gorontalo's fundamental growth is focused on three categories, namely human resources development, the agricultural sector with emphasis on rice and corn production, and the fisheries sector. With the population of barely exceeding 1 million people (43.36% of the working population are in the agriculture sector), the strategy towards advancement of Gorontalo province's economy must rely heavily on the influence of science, technology and innovation (STI). The Triple Helix system is being implemented in Gorontalo province to promote productive collaboration between the three main actors, namely PEMDA Gorontalo, local academia particularly the National University of Gorontalo, and local/national private business entities.

Keywords: Triple Helix system; Gorontalo province; local wisdom; indigenous knowledge and government policy

1. Introduction

Gorontalo, a province on the island of Sulawesi (Celebes), is a newly formed Indonesian province. It has a population of 1.038.585 (2010) and covers a total area of 12.215,44 km². Gorontalo acquired provincial status in 2001, having previously been regency. From historical background, Gorontalo was a territory that proclaimed her independence on January 23rd, 1942, before Indonesian independence on August 17th, 1945. That event, has always been a fundamental drive of all Gorontalonese to have the status of Gorontalo as an autonomous province.

In this paper we will describe Gorontalonese vision, plans and practical action already undertaken to implement the Triple Helix model of development in Gorontalo Province. Firstly we will describe the current profile of Gorontalo province. We will then outline current national/local government economic acceleration strategies, theoretical aspects of our vision and concrete steps already carried out to date.

Gorontalo is Sulawesi's smallest province in terms of population and area. Its main city, located in a valley surrounded by mountain ranges, was founded as a conglomerate of small kingdoms, historically the central hub for the Gulf of Tomini (called 'Golf van Gorontalo' by the Dutch who occupied the area in the 1700s). Today a significant number of prominent national figures today have close family ties with Gorontalo Province (including the 3rd president of Indonesia, several high ranking government officers, political elites, and senior businessmen).

Gorontalo is today ranked thirtieth amongst Indonesia's 33 provinces (province's GDP).

Gorontalo has a poverty level of 18.75% (2011), and this level has declined from 23.19% in 2010[1] but remains above the national average of 13.33% (2010). Gorontalo's poverty level is based upon expenditure per capita of Rp. 211,726.00 per month or roughly Rp. 7,000 per day (US$ 0.76), while the World Bank poverty level calculation base is US$ 2.00 (purchasing power parity) equal to Rp. 18,000 per day.

Gorontalo has an unemployment rate of 4.6% (2011), which is below the national rate of 6.80% (2011). 43.36% of Gorontalo's total labour force (456.499 persons) work in the agriculture sector; most of the remainder work in

[1] Data from National Statistical Bureau

medium, small and micro business entities (MSME). Gorontalo's infrastructure lags behind other provinces in Indonesia: the electricity ratio in Gorontalo province is 50.43%, compared to the national electrification rate of 72.03%. Although the local economy is heavily reliant upon the agriculture sector, Gorontalo province has only 3% of Sulawesi island's whole irrigation system (compared to 63% in South Sulawesi).

2. Background

2.1 Location; Heart of a Growth Area.

Gorontalo is favourably located at the heart of two growth area. These are the ASEAN Eastern growth area (BIMP-EAGA, comprising Brunei, Indonesia, Malaysia and the Philippines, established in 1994), and the Tomini Bay Growth Hub, established by Indonesian government decree[2] (2008). The province is bordered by the Celebes Sea to the North, Tomini Bay to the South, North Sulawesi province to the east and Central Sulawesi province to the west.

Gorontalo should be innovative to capitalize on its strategic location. It should utilize the major port of Bitung lying the east (in Northern Sulawesi Province), given that Gorontalo's economy does not yet support expansion of its own sea ports (Gorontalo port in Tomini Bay, and Kwandang in the Celebes sea up north). In the same time, Gorontalo should increase its domain within the Tomini bay region, as a central of the growth expansion area.

2.2 Conserving World Heritage[3]: Heart of Wallacea

Gorontalo Province is of international importance for its rainforest and wildlife. Gorontalo's Nantu Rainforest is renowned amongst conservationists as a global biodiversity hotspot. At Nantu, wild animals and birds found nowhere else on earth can be readily observed. Nantu lies at the heart of the Wallacea bio-region (which comprises Sulawesi, the Moluccas and the Lesser Sunda Islands). The Wallacean bio-region is characterized by an extraordinary mixture of both Asian and Australian wildlife species, and was first described by British explorer Sir Alfred Russel Wallace (1869). Wallacea is characterized by high species endemism; 62% of Sulawesi's mammals and 34% of its bird species are endemic (found nowhere else on earth).

The Nantu Forest is also extremely important in terms of the environmental services it provides: approximately 30,000 people live downstream within the Nantu (Paguyaman) watershed and are completely dependent upon the Nantu/Paguyaman rivers for their water supply. As a virgin rainforest ecosystem, Nantu's carbon content is invaluable, with over 13 million tonnes of biomass carbon stored. If the forest were cleared, up to 50 million tonnes of CO^2 could be released to the atmosphere.

2.3 Fading seamanship:

Gorontalo's people also have a long ancient tradition of harvesting from the sea. Using sailing boats of local design they have for centuries set sail on the tranquil waters of Tomini Bay, and also northwards to the great Celebes Sea. Today however outboard motors have replaced traditional wind-powered boats, and Gorontalo's rich fisheries are becoming over exploited.

Furthermore, Indonesia's huge marine resources are today stolen by foreign fishing vessels operating illegally within Indonesia's waters. Illegal fishing operators use large ships and receive assistance of corrupt local authorities. Small traditional fishermen are in no position to compete with these large-scale illegal operators, or the cheap prices at which fish from countries which condone illegal fishing are exported to Indonesia.

2.4 Promoting Higher Education for the Masses:

[2] Government decree: PP No. 26 Tahun 2008 tentang RTRWN
[3] Nantu Forest Conservation Fund Feasibility Report.

Gorontalo has upgraded its higher education facilities since becoming a Province. The National University of Gorontalo was established in 2004 by Presidential decree[4.] Prior to this Gorontalo had no University and facilities comprised the Junior College of Gorontalo, (founded 1963). This became the independent Teachers' Junior College of Gorontalo in 1993 and was upgraded to a full Teachers' College in 2001, coincident with the establishment of Gorontalo Province, finally becoming the National University of Gorontalo (2004). Today Gorontalo has several universities and higher education institutions; morover, the Gorontalo Islamic College is currently on process being upgraded to University status.

2.5 Local Wisdom:

Exposure to education in Gorontalo province has stimulated local invention, notably the 'bentor' (tricycle motorized rickshaw). This local invention, is a paradox for PEMDA, as it can be considered as neither brilliant, nor solution.

The roots of the bentor are found in the 'becak', a three-wheeled pedal-powered bike with front passenger seat which emerged onto the streets of Jakarta in 1936. This is the descendant of the original hand-pulled rickshaws from 19th Century Japan. More than 100.000 becaks operated in Jakarta in 1980 (accounting for 3% of Jakarta's work force), before being gradually banned by the government.

History has repeated itself in Gorontalo, where few alternative employment opportunities are available for the local work force. The enthusiastic marketing strategies by the motorcycle industry triggered an innovative group of high-school students in Gorontalo to invent the 'bentor'.

3. Indonesia: National Government & Triple Helix Societies

We will now consider Indonesia's national level development strategy, before applying lessons learned from this to Gorontalo Province. Overall, Asian economies can be categorized into three groups:

i) Countries with economies that have grown rapidly since the 1950s, avoiding the "middle-income trap" and becoming high-income developed economies in one generation;
ii) Countries, including Indonesia, whose economies have demonstrated consistently high growth since 1990 and have already reached middle-income status, but which now face the greatest risk of falling into the middle-income trap;
iii) Countries with economies that have achieved only modest growth.

Indonesia must embark on policies which address more inclusive, equitable sustainable long-term economic growth. It must radically broaden the energy mix, applying new and renewable energy sources, harness the full potential of entrepreneurship and innovation to create breakthroughs in science and technology, and improve governance.

By 2050, Indonesia's total population will be 288 million. In comparison, China's population will have more than 600 million people aged 60 and older by 2022 (out of total 1.4 billion), India will have population of more than 500 million people age 25 and older (out of total 1.3 billion), while by 2022 Indonesia will have 150 million people age 25 years and younger[4]. This constitutes an opportunity for Indonesia called the 'demographic dividend.'

One good example of managing strategy to escape from the middle income trap is South Korea (population 48 million), which has been able to capitalize on its demographic dividend through a labour-intensive, export-oriented industrialization strategy. It gave equal importance to promoting exports and to the nurturing a large domestic market. With its abundant natural resources, on paper, Indonesia should be able to do better than Korea.

[4] Figures gather from intrnet googleing.

3.1 Indonesia's Master plan for Acceleration & Expansion[5]:

Indonesia's "Master plan for Acceleration and Expansion of Indonesian Economic Development" (*Master plan Percepatan dan Perluasan Pembangunan Ekonomi Indonesia* – MP3EI), which is launched officially 27th Mei 2012, aims to drive high, balanced, fair and sustainable economic growth with prosperity for all citizens. Under this plan Indonesia will accelerate its prime economic sectors, increase infrastructure development and energy supply, and also develop human resources and science & technology.

Implementation of MP3EI incorporates 3 main elements:

a. Developing the regional economic potential in 6 (six) Indonesian Economic Corridors: (Sumatra, Java, Kalimantan, Sulawesi, Bali – Nusa Tenggara and Papua – Kepulauan Maluku Economic Corridors);
b. Strengthening national connectivity locally and internationally;
c. Strengthening human resource capacity and national science & technology to support the development of main programs in every economic corridor.

Implementation, involves 3 main stakeholder groups in national innovation systems, namely: (i) the government (regulator, facilitator and catalyst), (ii) business/industry (users of the invention), and (iii) research institutions and universities (sources of innovation). Close collaboration between the above groups is essential for the development of innovative products. Connectivity is a key pillar of the MP3EI program, including Physical, Institutional and Social Connectivity.

Provision of infrastructure to support economic activities is a major challenge for the huge archipelago of Indonesia. Infrastructure itself has a very broad spectrum. Connectivity between regions should be developed to accelerate and expand economic development. Provision of infrastructure which encourages connectivity will reduce transportation and logistics costs in order to improve product competitiveness, and accelerate economic growth. Connectivity infrastructure includes construction of transportation routes, information and communication technology (ICT), and associated regulations.

National Innovation System (NIS):

This plan also advocates promoting a system that would enhance the National innovation program (NIS, which was launched in 2009 by The Agency for the Assessment and Aplication of Technology/BPPT). The system would act to nurture local/national innovations, with beneficial rebound to Indonesia's economy and would then fuel regional and global economic development. NIS must be an integrated effort involving the actors of the Triple Helix, in order to gain momentum.

Acording to research conducted by INSEAD international graduate business school and research institution, in partnership with Alcatel-Lucent, Booz & Company, the Confederation of Indian Industry, and the World Intellectual Property Organization (a specialized agency of the United Nations), a research measures innovativeness for 125 economies rank Indonesia in 99th position[6].

Clear concept, commitment and strong support from all stake holders are required to develop this model. Currently Indonesia is regarded as the market for other countries (low value of local content if any) hence promoting NIS throughout Indonesia (including Gorontalo Province) is vital (in form of 'rural innovation system'/RIS).

Innovative capacity is a critical issue driving the forward thrust of both Indonesia and Gorontalo's economy. Unlike the studies conducted by INSEAD mentioned above, according to the World Economic Forum Report on Global Competitiveness Index that was announced June 2011, Indonesia ranked 44th among 139 countries, moving up 10

[5] Extract from the Indonesian goverment Masterplan for Acceleration and Expansion of Indonesia Economic Development.
[6] http://www.globalinnovationindex.org/gii/main/analysis/rankings.cfm?vno=a

notches since 2005, the strongest progress among G20 countries. An important benchmark in this assessment is 'capability for innovation,' on which Indonesia ranked 47th. This report highlights "*capacity* for innovation" as a fundamental problem in Indonesia (rank 53rd)[7].

Tight budgets and new scarcities are casting shadows throughout Indonesia, as elsewhere, amidst a changing international environment. This, combined with an increasingly demanding public, is putting governments under growing pressure to prove provision of good value for money, transparency and tangible results. Under the concept of "Managing for Development Results" (MfDR)[8] government (central/regional) would be able to set more clear, measurable and limited goals with concrete, time-bound targets.

4. Gorontalo: Local regional potential

The young Province of Gorontalo possesses unique characteristics as a dynamic entrepreneurial-driven province. With its small population and limited infrastructure, the first 10 years of its existence had been a period of transition to establish necessary basic provincial infrastructure.

Gorontalo is an ideal pilot/demonstration province in the decentralization era. Management systems can be tested in Gorontalo and data generated can be used as a bench-mark for other regions to compare innovative approaches. Several international institutions, such as UNDP, ILO, UNESCO, UNIFEM, WHO and UNOPS[9] are interested in Gorontalo province, and some have already finalized studies using Gorontalo as a sample area[10]. Several countries (including Malaysia, Tanzania & Sri Lanka) have applied lessons-learned from Gorontalo's 'agropolitan' programme in their own agricultural related activities.

Gorontalo's achievements in the agricultural sector are significant. Over the last decade Gorontalo's maize production has risen seven fold, from 81,720 ton (2001) to 679,168 tons (2010), while rice production has almost doubled (from 158,870 tons in 2001 to 253,563 tons in 2010). In 2011, production of maize and rice in Gorontalo province exceeded the national growth production. This achievement was made possible through provision of free corn and rice seeds to farmers, allocated from the provincial budget, as well as improvements in irrigation.

4.1 Gulf of Tomini Tourism and Aquaculture Hub:

Gorontalo possesses internationally important terrestrial and marine sites for eco-tourism. The Tomini Bay area including Gorontalo has been gazetted as a Tourism and Aquaculture hub (ratified by five cabinet Ministers and three Governors in 2008 – 9) on account of its marine riches. The Togean Islands, lying at the centre of Tomini Bay, are one of the world's well known, though inaccessible, tourist destinations, with access via Palu (Central Sulawesi) or Gorontalo. Improved transportation from Gorontalo to the Togean Islands would quickly increase Gorontalo's role as a tourism centre in the Tomini Bay area. Currently international tourists must either fly 5 hours from Jakarta then 8 hours by ferry to reach the Togian Islands via Gorontalo, or take a 4 hour flight, 8 hour bus-ride and 2 hour ferry-ride to arrive via Palu.

As mentioned earlier, Gorontalo Province is also home to the Nantu Rainforest, a pristine forest ecosystem of global importance for its unique "Wallacean" fauna. At Nantu unique animal and bird species found nowhere else on the earth, such as the Babirusa and the Red-knobbed Hornbill, can be readily observed in a virgin rainforest setting with gigantic rainforest trees. Primary intact rainforest of this kind is now extremely rare in Sulawesi and this, combined with a range of other interesting destinations in Gorontalo, makes the Province extremely attractive to international tourists.

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[7] http://www3.weforum.org/docs/WEF_GCR_Indonesia_Report_2011.pdf
[8] http://www.oecd.org/dataoecd/18/53/42447575.pdf
[9] http://pgsp-agi.org/agi/index.php?option=com_content&view=article&id=127%3Aprovincial-development-guidelines-of-gorontalo&catid=50%3Aguidelines-of-gorontalo&Itemid=102&lang=en
[10] http://www.undp.or.id/pubs/docs/PGSP%20-%20Strategi%20Pengembangan%20Kapasitas%2010%20SKPD%20Gorontalo.pdf

Regarding Aquaculture, Gorontalo's Government have attempted to diversify the province's traditional-based fisheries through sea-weed culture; domestication of brackish water fish to salt-water (milk-fish) and promoting farming of the popular Tomini Bay stonefish are other options to be pursued.

4.2 Culture and Demography:

Gorontalo is also known as a cultural and commercial hub in Sulawesi. Its strategic location, facing Tomini bay to the South and Celebes sea to the North, have made it a central point for the spread of Islam throughout Sulawesi (Ternate, Gorontalo, Bone route). While Islam has already been in Ternate since 1500 AD, the spread of Islam in Gorontalo started as early as 400 years ago. In addition, Gorontalo is a main hub for ethnic Arab Indonesians from Ternate to networking with other cities in Sulawesi. Christianity also developed in some regions of Sulawesi as a result of Dutch occupation. eg. most of the Minahasa populated region was already Christian by the 18th century, as were small portions of Central Sulawesi, and large areas of the Maluku islands.

In the 20th century, regions around Gorontalo experienced sectarian conflict, causing the region to be viewed as a trouble-spot. Ongoing Moro separatist (Moslem) rebels have been active to the North (Mindanao, Philippines) against the central government since the 1970s, causing more than 120,000 casualties. Closer to the South, in Poso by Tomini Bay, a severe sectarian conflict occurred for several years with casualties of more than 1,000, while to the east across the Molucan sea, the Maluku islands was also caught in the sectarian conflict for several years, causing more than 2,000 deaths.

Despite these turbulent past events, Gorontalo is a peaceful and tolerant Province, and would be well suited as a centre for Islamic peace dialogue in the broadest sense (involving the BIMP-EAGA member countries[11]). Gorontalo province has a more than 95% Muslim majority, but was originally part of North Sulawesi province, lying to the East, where more than 90% of the population are Christian. Many Gorontalonese people live in North Sulawesi's capital, Manado, which is 30% Muslim. This demographic situation proves that citizens of all areas in northern Sulawesi are well adapted to peace within religious diversity, and this positive atmosphere should be translated into economic stability for expansion.

5. Plan of action

5.1 Triple Helix Model Implementation

Turning to the Triple Helix Model, Gorontalo's government, University and Business circles have agreed to accept this method. They recognize the strength of its synergistic nature, and the need to bring actors together to establish mutual trust. These stakeholders have agreed upon the need for a **"Centre of Social of Science, Technology and Innovation"** in Gorontalo (abreviated"PSSPI" in Indonesian language). Key actors will include the Provincial Government, the National University of Gorontalo (UNG) and private sector Businessmen. UNG is one of the most credible actors in the province, employing more than 100 graduate teaching staff, 30 post-doctoral lecturers and with more than 10,000 students. This PSSPI is envisaged as the central nerve system of an 'innovation cluster,' a central network of interrelated organizations, intended to jump-start competitiveness of Gorontalo province at a regional scale.

The philosophy underpinning the PSSPI is summarized by Ernest J. Wilson III, who said: "To generate one groundbreaking technological development after another, innovation must be embedded within long-lived social institutions and networks. *Four different sectors* must be linked together: government, business, civil society (not-for-profit organizations), and academia. This is what I call 'the quad.' In such an environment, creativity needn't wait for the unpredictable 'aha' moment. It is continually nurtured. The decisions made at every level — investment

[11] Central Sulawesi province (bordered with Gorontalo in the West) has 72.36% Muslim population, 24.51% Christian, and 3.13% Budha.

funds, corporate engineering teams, regional planning boards, philanthropic councils, academic faculty reviews, and many more — are naturally aligned."[12]

Key pillars to achieve a functioning PSSPI are as follows:

1. The PSSPI should construct cross-sector networks that are richer, more diverse, and more deliberately structured than those of the past.
2. Leaders should continually reform the way their organizations are managed — creating a climate that fosters innovation, and adjusting the incentives and organizational structures to reward creativity and collaboration.
3. Leaders should invest in talented, innovative individuals, attracting, retaining, and empowering the right mix of people who can foster serial innovation.

The initiative to apply the Triple Helix concept arose from the Indonesia-wide Association of Gorontalonese Citizens (KKIG) after extensive discussion in Gorontalo and Jakarta. Although it seems to be reffered as 'civil society' in Wilsons' 'the quad,' it basically can be grouped as the academia. The common purpose of this group is to support and "give-back" to the land of their origin. The group comprises Gorontalonese scholars, scientists, professors, civil servants and a wide diversity of businessmen, who now live outside Gorontalo. Land for the PSSPI operation centre has already been gifted to the National University of Gorontalo by certain prominent KKIG scholars.

The PSSPI will become the center for Science, Technology and Innovation in Gorontalo. Its immediate task will be to enhance local Gorontalo Province's resources. PSSPI will conduct social studies on local issues, compile all relevant STI information and disseminate information to all actors in Gorontalo Province. PSSPI will strengthen the local human capital by improving networking both nationally and internationally. PSSPI will also conduct extensive interdisciplinary coordination, to come up with solutions uniquely tailored for local requirements.

PSSPI will be focused on three groups of scholars, scientists and academics, from several different disciplines whose back ground is in technology, humanities and social science, namely:

a) Scientists and technical engineers,
b) Economists and political and social science scholars,
c) Groups with specialist knowledge on key issues relevant to Gorontalo, such as aqua- culture, tourism, conservation and corn and rice agriculture.

PSSPI will be a founder model of its kind, replicable by other regions. Its operational system will be easily repeatable in other innovation clusters, with the active assistance of PSSPI. While constituting a specific regional study centre PSSPI will be fully integrated into academic structures, making it possible for participating students/faculty members/ government employees to earn cumulative academic credit and/or special certificates.

It will publish reports and research related to local issues, which will serve as reference for the other regions both in Indonesia and abroad.

5.2 PSSPI Agenda:

Gorontalo's Triple Helix Initiative partners have already finalized the PSSPI centre establishment, which is located within the National University of Gorontalo complex (UNG). Students will build the centre, funded by local government, on the land already donated. In parallel, the actors will establish the organization body, comprising government officers (ex officio), academics (from different universities and colleges), and societies (including businessmen, scholars and private individuals).

Several PSSPI agendas are already developing, including:

[12] http://m.strategy-business.com/article/12103?gko=ee74a

- Increasing rice production in Gorontalo by possible promotion of artificially radiated rice seedlings (developed by Indonesian's National Nuclear Energy Agency).
- Geothermal energy investment opportunities (e.g. a small scale geothermal power plant, 7 x 2 MW) to complement construction of a coal-power energy plant (2 x 12.5 MW) already being implemented by a KKIG member.
- PSSPI will implement buffer zone livelihood assistance micro entrepreneurship initiatives to support conservation of the Nantu Rainforest.
- PSSPI will develop programmes to promote foreign tourism to Gorontalo, bringing this into line with other areas. A total of only 455 registered foreign tourists visited Gorontalo in 2010, while 4,000 foreign tourists visited the Togean island in Tomini Bay in the same year.
- PSSPI will encourage engineering innovation, addressing genuine local concerns such as revitalization of the motorized tricycle 'bentor.' PSSPI will formulate programs to encourage bentor owners to convert to a more acceptable and economical design.
- PSSPI will implement a study on development of aqua-culture in Gorontalo, including seaweed farming and possible domestication of brackish water fish into salt-water
- Sailing boats are a fading heritage of Gorontalo. Five hundred years ago sailing boats were the main means of transport from Gorontalo across Tomini Bay. In 2014 three provinces of the Tomini Bay area will host the 'Sail Tomini' festival, inviting sailing boats from around the Asia Pacific to visit the region. By then, Gorontalo should already have a new but traditional sailboat that is fast and agile. This festival will be the starting point for Gorontalo as the new hub of marine activities in the region.

6. Summary and Conclusion

The main objective of this paper has been to summarize the evolution of a new province, Gorontalo, from its early creation to the current transitional stage, on its path towards becoming a self-sufficient, mature province at the hub of the East Asian region. ***All components of Gorontalonese society are united in following this path*** towards establishing Gorontalo as a modern developed regional centre.

We note the blueprint of Indonesia's central government for 2025 is "to Create a Self-Sufficient, Advanced, Just, and Prosperous Indonesia." This involves developing centres of economic excellence throughout each of six corridors, including that of Sulawesi island. However, possibly due to its small size and population, no strategic economic targets have been specified for Gorontalo Province, whose main strength is seen to be maintaining a rice production surplus.

It is now the sole responsibility of the Gorontalonese, to create change in Gorontalo province. Globally Indonesia is ranked 17th in the world economy, with the income per-capita of US$ 3,000 (2010) and by 2025 it is expected that Indonesia will be amongst the top ten largest economies in the world, along with China and India. Looking forward we, the Gorontalonese, do not wish the Province of Gorontalo to remain in 30th position out of 33 provinces (as indicated by poverty level and unemployment rate). The simple way to increase the prosperity of Gorontalo province is to expand economic volume. With the limited resources available to the province, the only logical solution is to incorporate science, technology and innovation in to the economy of Gorontalo province through a close collaboration of actors in the Triple Helix based program.

7. REFERENCES

- Amin , Basarei. 2012. Memori Gorontalo,Teritori-Transisi-Tradisi. Ombak Jogja.
- BAPPENAS – RKP 2012, Bab V Pengembangan Wilayah Sulawesi Tahun 2012
- Central Bank of Indonesia Gorontalo Province. 2012. http://www.bi.go.id/NR/rdonlyres/A10E5F93-21C7-4D8C-863E-32DB19C8A387/23837/KERProvinsiGorontaloTWII20114.pdf (Accessed April 15, 2012).
- Coordinating Ministry for Economic Affairs. 2011. ACCELERATION AND EXPANSION OF INDONESIA ECONOMIC DEVELOPMENT 2011-2025; http://www.ekon.go.id/media/filemanager/2011/05/27/p/d/pdf_mp3ei.pdf (Accessed April 15, 2012)
- Diskoperindag Kab./Kota. 2009. http://www.smecda.com/kajian/files/kjdaerah/Gorontalo_2009/Bab_4.pdf (Accessed April 15, 2012).

- **Damis , Mahyudin. 2010.** Mengapa GorontaloMemisahkan Diri?; http://mahyudindamis.wordpress.com/2010/05/18/%E2%80%9Cmengapa-gorontalo-memisahkan-diri%E2%80%9D/ (Accessed April 15, 2012).
- Dwiana, Hercahyani. 2008. Sejarah Pembentukan Gorontalo dari Kabupaten Menjadi Propinsi 1953-2000, Thesis Program Studi Ilmu Sejarah Program Pasca Sarjana Fakultas Ilmu Pengetahuan Budaya Universitas Indonesia Depok.
- Habibie, B.J. 2006. Detik-Detik yang Menentukan,Jalan Panjang Indonesia Menuju Demokrasi. THC Mandiri
- Iskandar, Marzan A. 2010. Peran BPPT dalam PENGUATAN SISTEM INOVASI UNTUK DAYA SAING DAN KEMANDIRIA BANGSA; http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=4&ved=0CD0QFjAD&url=http%3A%2F%2Fgin.web.id%2Findex.php%3Foption%3Dcom_docman%26task%3Ddoc_download%26gid%3D38%26Itemid%3D214&ei=BHiRT5W9AsjtrAes7sDtBA&usg=AFQjCNEMsvFnrCmHjoUzCM6AsJvU0l7qmQ&sig2=un0ZoyCxZrhhTiOeJa2-aA (Accessed April 15, 2012).
- Kementerian Negara Lingkungan Hidup. Press Release 2010. Pengelolaan Teluk Tomini secara Terpadu dan Berkelanjutan; http://xa.yimg.com/kq/groups/23081136/1898417260/name/Agreement (Accessed April 15, 2012)
- M. Eko Rudianto. 2011. Pengembangan Kawasan Ekonomi Kelautan dan Perikanan Sebagai Pilar Peningkatan Kualitas Kehidupan Masyarakat; Direktorat Tata Ruang Laut Pesisir dan Pulau-Pulau Kecil, Direktorat Jenderal Kelautan Pesisir dan Pulau-Pulau Kecil Kementerian Kelautan dan Perikanan.
- Muhammad, Fadel. 2008. Reinventing Local Government/Pengalaman dari daerah(Gorontalo). Kompas-Gramedia
- Norton, Rob. 2012. The Innovativeness of Nations; http://www.strategy-business.com/media/file/00100-The-Innovativeness-of-Nations.pdf (Accessed April 15, 2012).
- OECD. 2008. Managing for Development Result; www.oecd.org/dac/effectiveness/result (Accessed April 15, 2012).
- UNDP. 2009. Tinjauan Kapasitas 10 SKPD Pemerintah Provinsi Gorontalo; http://www.undp.or.id/pubs/docs/PGSP%20-%20Strategi%20Pengembangan%20Kapasitas%2010%20SKPD%20Gorontalo.pdf (Accessed April 15, 2015).
- World Economic Forum. 2011. The Indonesia Competitiveness Report 2011. http://www3.weforum.org/docs/WEF_GCR_Indonesia_Report_2011.pdf (Accessed April 15, 2012).

I. Triple Helix Model for Government Institution

OUTLOOK FOR THE SCIENCE, BUSINESS AND STATE INTERACTION DURING THE PERIOD OF INNOVATION ECONOMY DEVELOPMENT IN RUSSIAN FEDERATION

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Abstract
The strategy of development. Russia has chosen the course of innovations, however, the ways of creating innovation economy and the theoretical background are not clear yet. However, the triple helix theory is the most acceptable for Russia. The triple helix system can be easily applied to different spheres of economy. Some spheres of Russian economy can use the triple helix system. An example can be found in the field of bridge development. This example is the cable-stayed bridge in Vladivostok. This article can be interesting to economists, students and concerned people in the developing of the triple helix model.

Keywords: Strategy of development, Model innovation systems, The bridge development project

INVESTIGATING THE USEFULNESS OF TRIPLE HELIX AS AN INNOVATION POLICY FRAMEWORK FOR UNIVERSITY TRANSFORMATION IN IRAN

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Abstract
Innovation has been the subject of many studies for more than half a century due to its prominent role in socioeconomic sustainability and long term growth. Thus, in attempts to explain the innovation process and its determinants, different models have been proposed so far. Triple helix is one of the latest models which highlight the role of university in the innovation process. The Triple Helix model of "university–industry–government", by Etzkowitz (1997), is an emerging alternative model for explaining the innovation process in the socioeconomic context. However, different possible relations among the 3 institutions have been resulted in creation of different types of this model. This study aims at investigating the key features of the triple helix model with the purpose of drawing innovation policy implication for the context of Iran as a resourcebased economy with state-owned industries that have encountered several difficulties in the trilateral University-Industry-Government (UIG) linkage. In this regard, first, university evolution history in Iran is reviewed and policy gaps are analyzed based on the triple helix model. Then, the UIG collaboration case of Iran Transformer Research Institute (ITRI) is mentioned to support the claims in the previous part. Finally, some policy suggestions are concluded in order to improve the innovation policy in Iran based on the triple helix model.

Keywords:Innovation Policy, Triple Helix,UIG

1. Introduction

Innovation can be defined as a complex event that results when a confluence of contextual, structural and dynamic-process factors produce new social benefits, greater economic efficiency and enhanced sustainability. In this part, the history of innovation studies and the emergence of triple helix have been reviewed.

1.1. History of Innovation Studies

Innovation studies began to emerge as a separate field in the late 1950's. However, in the first half of the twentieth century, few economists started to recognize the contribution of innovation to economic development. In particular Schumpeter was the one who stressed the role of entrepreneurs and organized industrial R&D in developing innovations. From an Economical point of view, the work by Griliches (1957) on the economics of technical change and on rates of return to R&D and that by Nelson (1959) and Arrow (1962) on the economics of research were the major building blocks of innovation studies who stressed the prominent role of technical change in long-term growth. In the mentioned studies, scientific knowledge was considered as a ‘public good’, in which ‘market failure’ occurs. This, in turn, constructed a rationale for government to fund research and innovation along with industry (mainly firms) and university (and other research centers) as the traditional demand and supply side respectively. The work of Schmookler (1966) on Invention and Economic Growth paved the way for the ‘demand-pull model’ of innovation in competition with the above mentioned ‘science-push model’. Also, Mowery & Rosenberg (1979) conducted empirical studies on the influence of market demand on innovation. Kline and Rosenberg (1986) proposed the chain-linked model of innovation based on the historical studies of technological development, emphasizing the crucial role of the demand side in the innovation process and stressing the importance of government- direct and indirect- capacity building as the main feature of the mentioned model. From a traditional point of view, Academic institutions usually possess the human and physical capital required to propose innovative ideas or conduct R&D. Industry possesses the human resource and physical capital that are typically required to adopt/incorporate new knowledge and technology into manufacturing processes and commercializing them. Therefore, in this viewpoint, academia and industry attempt to spread the cost of efforts to innovation and government; on the other hand, they have a responsibility to resolve market failures and to produce social benefits. This characterizes a nonintegrated, virtually independent, but well-established trilateral collaboration in the innovation process. In an effort to systematically integrate formulation of the innovation process, the concept of innovation systems emerged in the late 1980's. National system of innovation (NSI), proposed by Freeman 1987, Lundvall 1993, and Nelson 1993, encompass several institutional factors, their functions and linkages in the innovation process. It is also mentioned that innovation is the output of a complex and non-linear interaction between academia, government and industry. This model, which considers the firm as having the leading role in innovation, has historically been important in determining competition nationwide.

2. Triple Helix

The Triple Helix model of "university–industry–government", by Etzkowitz (1997), is an emerging alternative model for explaining the innovation process in the socioeconomic context. Different possible relations among the 3 institutions are explained as:

- Triple Helix I: the state encompasses academia and industry and directs the relations between them.
- Triple Helix II: suggests separate institutions with strong borders dividing them and highly circumscribed relations among the spheres.
- Triple Helix III: overlapping institutions, each taking the role of the other and with hybrid organizations emerging at the interfaces.

Etzkowitz & Leydesroff (2000) state that "Triple Helix I is largely viewed as a failed developmental model. With too little room for ‘‘bottom up’’ initiatives, innovation is discouraged rather than encouraged. Triple Helix II entails a laissez-faire policy, nowadays also advocated as shock therapy to reduce the role of the state in Triple Helix I .In one form or another, most countries and regions are presently trying to attain some form of Triple Helix III."

Indeed, it is only through such integrated trilateral interaction that the social, economic, and sustainability benefits of triple helix innovations can be fully articulated. As mentioned, in the triple helix approach universities are the key player and contributor to the innovation process. In this regard a brief history of universities mission transformation worldwide is mentioned here to bring about the possibility of mapping the university missions with UIG evolution.

2.1. University Transformation in Brief

Universities were established 8 centuries ago as state-owned institutes with teaching as their main mission. The principle job of universities was to provide the human resource for industry using governmental budget. The first academic revolution started in Germany in late 19 century, introducing research as the new university mission. In this period, the universities dependency on the government budget started to decrease and the university-industry collaboration was fortified. Formation of Industry University Cooperative Research Centers (IUCRC) as an interfacial institution started from this phase of evolution. The second revolution, emerging since the end of the Cold War, stressed the role of university in the economic development, has opened up the third mission for this institution. Formation of Spinoff firms around universities, participation of universities up to commercialization phase of technology and inclusion of social responsibility in the university function is the key features of this transformation (Clark 2000). Thus the triple set of mission for modern universities can be defined as: 1- Teaching 2- Research 3- Direct contributions to socioeconomic development Some universities have transformed, during the time, from mere educational institutions to research and finally entrepreneurial institutions and many others are still undergoing this transformation of purpose. But the question remains that what are the requirements and obstacles of the mentioned transformation in a resourcebased economy like that of Iran? This can be posed in other words with questioning the series of mechanisms for identifying and enhancing the applicability of research findings to be effectively transferred to the industry. In the following parts much attempt has been made to deal with the question based on the triple helix approach.

3. Analyzing the University Evolution in Iran

Traditional universities were shaped in Iran several centuries ago. However the foundation of modern nationwide universities in Iran dates back to the early 1930's with the establishment of Tehran University as an educational institute. In early 1960's the apprenticeship period was defined for university students as the initial form of university-industry linkage. In the mentioned period, university students participated in a 3-month training program in the industry related to their field of study. However, industry relation offices were first set up at university in 1982 with the purpose of institutionalizing the industry-university linkage. In a gradual process since mid 1990's, incubators, technology parks and other periphery institutions started to form around the academic heartland in the universities to stimulate the entrepreneurship culture in the universities and diversify the university fund resources to reduce the dependency of universities on the government budget. The following case can be suggestive of universities effort to set up the basis for trilateral collaboration.

4. Case of Iran Transformer Research Institute

Sharif University of Technology (SUT) is the most prestigious university in Iran with more than 8000 students and 400 faculty members. The Faculty of electrical engineering at SUT is one of the top faculties worldwide. In 2000, in cooperation with Iran Transfo Co. (ITC), a transformer production firm, as an industrial institution and the Technology Cooperation Office (TCO) as a governmental participant, founded the Iranian Transformer Research Institute (ITRI) to serve the needs of industry R&D in the design and manufacturing of new transformers. Sharif University was to provide the human resource and technological knowledge for the demand proposed by the industry and joint funding of government and industry. In the following the growth phases of ITRI is outlined:

- ❖ Phase 1(1999-2001): Acting as the reference laboratory of ITC for final product quality control- totally dependent on the government-industry budget
- ❖ Phase 2(2001-2003): acting as the research center for technology improvement in the firm- totally dependent on the government-industry budget
- ❖ Phase 3(2003-2006): acting as a partner to the design office of ITC- starting to diversify the fund resources with the purpose of decreasing the dependency to the government budget.
- ❖ Phase 4(2006 onward): acting as an independent research center, with service oriented architecture- with diversified funding resource. The focal activity in this phase is the technological consultancy and technology transfer for different firms in Iran.

5. Conclusions and suggestions

As can be noticed from the economic literature for a resource-based economy such as that of Iran (60% of public budget and around 30% of the GDP relies on crude oil and gas), the government prefers to procure the final technological products for the state owned industry from a safe and sound external source. Thus the government will have no incentive to push the actors for innovation. This will, in turn, discourage the industry from collaborating with universities with the long-term perspective. In this atmosphere the universities with decreasing dependency to the government fund cannot easily push the way of innovation forward. As the government fund is not allocated to the universities on the result-based policy. According to the framework proposed in triple helix III, the following policy implications can be drawn from this model for the context of Iran:

- The Triple Helix Innovation process is characterized by academia (A), government (G), and industry (I) playing fully integrated and overlapping roles which states that the university can play an enhanced role in the innovation process.
- The Innovation process typically begins with the formation of a social mission, which may arise in any sector but is often championed by government. Once the social mission is established, institutional units are drawn into collaborative funding, R&D, and commercialization processes.
- The interfacial institute will dissect the process to determine which combination of financial, human and physical capital, material, locational, cultural, and organizational inputs converge to produce a successful trilateral interaction.

Thus the interface strategies and institutions must be reshaped, and invented in some case, in order to integrate market pull and technology push through new organizational mechanisms in Iran.

References

Arrow K. J., ‘Econ welfare and alloc of resources for invention’ in Nelson, (1962)

Clark B, Beyond the Entrepreneurial University? The 15th IMHE, (2000) Education Management, 13(2), 200l. See Clark, 2001 – Etzkowitz, H., & Leydesdorff, L. (Eds.), Universities in the global economy: A triple helix of university-industry-government relations. Cassell Academic, London. (1997).

Etzkowitz, H., & Leydesdorff, The dynamics of innovation, *Research Policy*, (2000)

Freeman, C. Technology Policy and *Economic* Performance: Lessons from Japan. Pinter, London, (1987) Griliches Z., ‘Hybrid corn … economics of tech change’, *Econometrica*, (1957)

Kline S.J., Rosenberg N., ‘Overview of innovation’, in *Positive Sum Strategy*, (1986)

Lundvall, Bengt-Åke, National Systems of Innovation, (1992)

Nelson R., ‘The simple economics of basic research’, *J Pol Econ*, (1959)

Nelson, Richard R. (ed.), National Innovation Systems: A comparative study. Oxford University Press, New York, (1993)

Schmookler J., *Invention and Economic Growth*, (1966)

R&D AND PATENTS: AN ATTEMPT OF APPLICATION OF THE GRILICHES'S MODEL IN A TRANSITIONAL ECONOMY

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Abstract
Patent may be treated as a certain link connecting the R&D sector with industry, because if the invention creator (an individual or an organization) takes a decision to apply for patent it means that he/she can see a commercial potential of the future innovation that will be based on this invention. In turn, inventions appear mainly in the R&D sector, part of which are universities, other higher education institutions, public research institutes, industrial R&D organizations, etc. Finally, a national patent office which usually is a government institution may be treated as a kind of liaison office. As seen, all the three actors in the Triple Helix model are engaged here.
Inventions and patents have fascinated economists for a long time. Following Rosegger (1986), we may speak of the production of inventions – which usually become patented - as an economic activity, because it requires the commitment of resources to the purposeful search for new knowledge. Therefore, many investigators have dealt with the economic analysis of patent activity. Among them – Griliches (1990), Pavitt (1996) and Stoneman (1987).
In his probably the most famous work, Griliches (1990) analyzed relationships between R&D and patents in the United States in the post-war period. He argued that patents are a good index of inventive activity, a major aspect of which is measured by research and development expenditures. Then he proved that there is quite a strong relationship between R&D and the number of patents received at the cross-sectional level, across firms and industries.

Keywords: R&D, invention, patent, transitional economy

1. Patent activity and R&D expenditures in Poland in the transition period

Data on patents and R&D expenditures in Poland in 1990-2010 are presented in Table 1.

Table 1. Patents and R&D expenditures in Poland, 1990-2010

Year	Domestic patent submissions	Domestic patents issued	GERD in $mil (constant prices of 2005)	GERD/GDP (in %)
1	2	3	4	5
1990	4105	3242	2741.35	0.96
1991	3389	3418	2142.68	0.81
1992	2896	3443	2258.72	0.81
1993	2658	2641	2342.01	0.86
1994	2676	1825	2267.97	0.82
1995	2595	1619	2196.19	0.69
1996	2411	1405	2411.50	0.71
1997	2339	1179	2576.42	0.71
1998	2407	1174	2764.25	0.72
1999	2285	1022	2989.32	0.75
2000	2404	939	2912.03	0.66
2001	2202	851	2850.42	0.64
2002	2313	834	2595.00	0.58
2003	2268	613	2605.50	0.56
2004	2381	778	2831.06	0.58
2005	2028	1054	2982.43	0.57
2006	2157	1122	3106.64	0.56
2007	2392	1575	3384.08	0.57
2008	2488	1451	3790.48	0.60
2009	2899	1536	4303.67	0.67
2010	3203	1385	4876.09	0.74

Sources: [1] and [2]

The following conclusions can be drawn from Table 1:

- The number of domestic patent submissions (Ps) showed a steady tendency to decrease in 1990-2004. The decline was stopped in 2005 and a systematic growth started in 2006 (see also Fig 4. in Appendix A);
- The number of domestic patents issued (Pp) showed a permanent declining tendency till 2003. The decrease was stopped in 2004 and a tendency to increase – with fluctuations – began in 2005 (see Fig 5.);
- National expenditures on research and development (GERD) showed a tendency to decrease – with fluctuations – in 1990-2002. The starting level of GERD was achieved in 1998 and again in 2004. A permanent increase started only in 2003 (Fig 6.);
- A systematic decline in the GERD/GDP indicator took place till 2002. In 2002-2007, its value stabilized at a very low level (0.56-0.58). Then the coefficient showed a constant growth from 2008 (Fig 7.);

The above declining tendencies were very worrying. The situation began to improve around 2004 when Poland became a member of The European Union. However, the number of patent submissions and patents issued in 2010 were still smaller than at the beginning of the period under analysis. The GERD/GDP ratio did not come back to the starting level either.

Various factors influence patent activities in firms, R&D institutions and other organizations (see, e.g. [3]). Among them, there is probably the most important factor, i.e., R&D expenditures. This relation may be explained as follows:

the result of research and development is production of new (scientific and technological) knowledge, including inventions,

a growth of R&D expenditures brings a growth of production of this knowledge, including inventions,

when the knowledge production rises – an increase can be observed in the number of patent submissions, i.e., inventions submitted to a legal protection,

an increase in patent submissions brings – although not immediately – a growth of patents issued (a new patented knowledge), i.e., inventions protected by patent.

2. Patent activity and R&D expenditures in Poland in the transition period

Inventions and patents have fascinated economists for a long time. Following Rosegger [4], we may speak of the production of inventions – which usually become patented - as an economic activity, because it requires the commitment of resources to the purposeful search for new knowledge. Therefore, many investigators have dealt with the economic analysis of patent activity. Among them – Griliches [5], Pavitt [6] and Stoneman [7].

In his probably the most famous work, Zvi Griliches [5] analyzed relationships between R&D and patents in the United States in the post-war period. He argued that patents are a good index of inventive activity, a major aspect of which is measured by research and development expenditures. Then he proved that there is quite a strong relationship between R&D and the number of patents received at the cross-sectional level, across firms and industries.

For this purpose, Griliches [5] constructed the linear model of 'knowledge production function' as follows:

$$P = aK + v = aR + au + v \qquad (1)$$

where:

P – patents,

R – research expenditures,

K – additions to economically valuable knowledge,

u – other sources of knowledge growth,

v – random variable,

a – structural parameter of the model.

Afterwards he estimated the regression function $P = aR + au$ for the period of 1953-1989. The estimated elasticity of R&D with respect to patents was 0.76, i.e, rather high.

Thus, it may be said that, in the long period, there exists a positive relation between R&D and patents which means that the number of patents increases together with the growth of the expenditures on research and development.

Now, a question has emerged: *Does the Griliches's model work in other countries, especially in transitional economies?* Poland here will be a case-study and the macro-perspective will be considered.

3. An empirical verification in Poland

Patent may be treated as a certain link connecting the R&D sector with industry, because if the invention creator (an individual or an organization) takes a decision to apply for patent, it means that he/she can see a commercial potential of the future innovation that will be based on this invention.

In order to find how strong this connection/relation is, a crucial question is: How to measure both variables ('patents' and 'R&D')?

As far as patent activity is concerned, the number of patent submissions seems to be a better measurement than the number of patents issued because:

patent submissions better express the essence of patent activity and patent submissions are more directly connected with R&D activity.

So, the number of domestic patent submissions (Ps) has been chosen as the endogenous variable. In turn, the exogenous variable will be GERD in $mil (in constant prices) due to the fact that, in macro-analysis, research activity is usually expressed by R&D expenditures, universally by GERD. However, we must be fully aware that research expenditure is an input but rather not an output of research production.

An econometric model has been chosen as an analytical tool. Several attempts were done to find an adequate model describing patent-R&D relations in 1990-2010. In each case, the Engle's-Granger's procedure and the Johansen's procedure [8] were applied to estimate both long-term relation models as well as models with the vector error correction (VEC). (The VEC model allows us to incorporate both the long-term and short-term relations at the same time). Afterwards, in each case, the best model was chosen using the determination coefficient R-squared, AIC (Akaike Information Criteria) and the significance of parameters as three main model quality measurements.

3.1 The models based on absolute values

Using the Johansen's procedure, the following relations were obtained:[1]

The long-term relation model:

$$Ps_t = 484.94 + 0.74 \cdot GERD_t \tag{1}$$

The model with vector error correction:

$$\Delta Ps_t = -45.1 - 0.35 \cdot \left(Ps_{t-1} - 484.94 - 0.74 \cdot GERD_{t-1}\right) \tag{2}$$

R-squared = 0.73, so is relatively high.

Report on estimates of parameters in model (2) – see Table 2. in Appendix B.

The estimated long-term relation model means that the increase in GERD by $100 mil brings the increase in the average number of domestic patent submissions by 74 submissions. In 1990-1995, the decreasing GERD pulled patent submissions down, then there were seven years of fluctuations, and finally, in 2003-2010, the growing GERD pulled the submissions up (see Fig 1).

[1] This procedure gave better results than the Engle's-Granger's procedure.

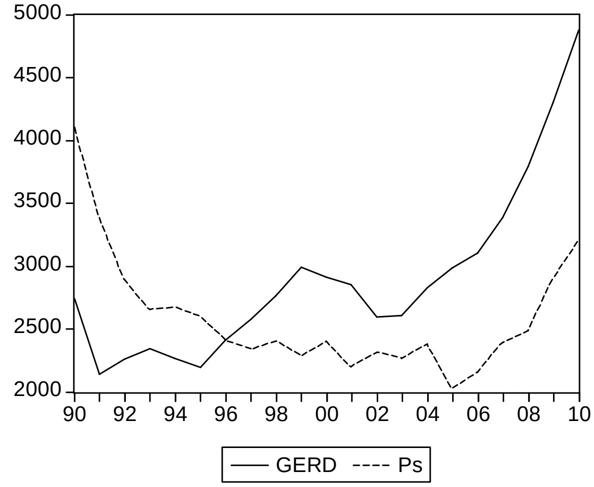

Fig. 1. Curves of patent submissions and GERD in 1990-2010 (absolute values)

Below is Fig 2 showing the relation between patent submissions and GERD. Unfortunately, the figure is not fully explicit because of the observed – as in Fig 1 – deviation of the long-term equilibrium in 1996-2002.

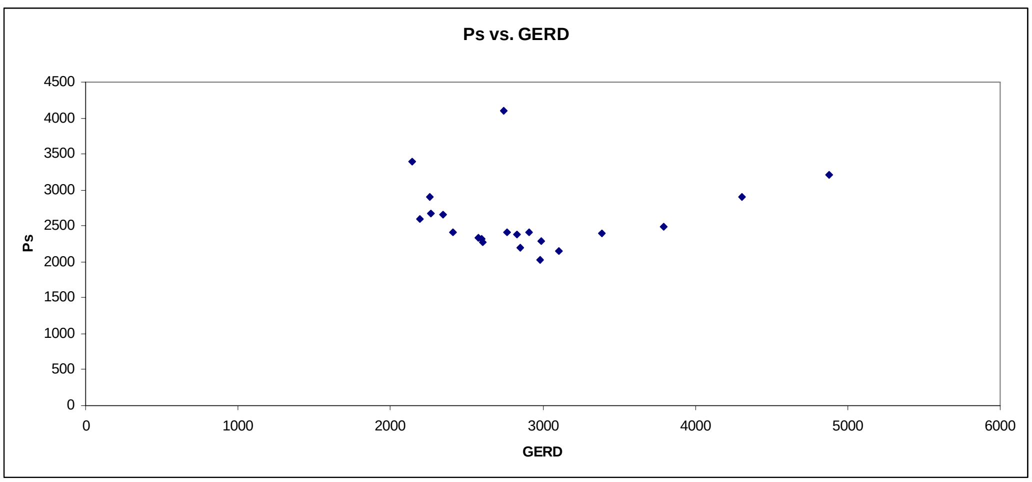

Fig. 2. Patent submissions versus GERD (absolute values)

3.2 The models based on logarithms

In order to ascertain the elasticity of patent submissions with respect to GERD, the following relations were obtained using the Johansen's procedure:[2]

The long-term relation model:

$$\log(Ps_t) = 1.15 + 0.84 \cdot \log(GERD_t) \tag{3}$$

[2] Also in this case, the Johansen's procedure gave better results than the Engle's-Granger's procedure.

The model with vector error correction:

$$\Delta \log(Ps_t) = -0.012 - 0.30 \cdot \left(\log(Ps_{t-1}) - 1.15 - 0.84 \cdot \log\left(GERD_{t-1}\right)\right) \tag{4}$$

R-squared = 0.60, so is high enough.

Report on estimates of parameters in model (4) – see Table 3. in Appendix B.

The long-term elasticity of domestic patent submissions with respect to GERD is 0.84 - very high. This result corresponds with the result gained by Griliches (0.76) who has estimated his model based on logarithms, too.

The curves of the logarithms of patent submissions and GERD have the same shapes as in Fig 1, which is obvious.

3.3 The models of relation between patent submissions and the GERD/GDP coefficient

Finally, let's check whether there is any relation between domestic patent submissions and the GERD/GDP coefficient. This universally accepted indicator well shows a real scale of the whole country's financial effort for research and development. Truly speaking, a first such attempt was undertaken three years ago [9]. For the period 1990-2007, the following linear model was estimated:

$$Ps_t = 3839.8 \cdot GERD_t / GDP_t \qquad \text{R-squared = 0.54 (acceptable)} \tag{5}$$

which can be interpreted as follows: the increase (decrease) in the GERD/GDP coefficient by 0.10 brought the growth (decline) of the number of patent submissions by 384.

Now, having a bit longer time-series (for 1990-2010), we estimated the same model representing a long-term relation between patent submissions and GERD/GDP:

$$Ps_t = 3729.1 \cdot GERD_t / GDP_t \tag{6}$$

R-squared = 0.57 (acceptable).

Report on estimates of parameters in model (6) – see Table 4. in Appendix B.

So, the change in the coefficient by 0.10 brings the change in the number of patent submissions by 373 (going to the same direction). This is well presented in Fig 3 which shows that, during the better part of the period under analysis, the decreasing GERD/GDP ratio pulled patent submissions down.

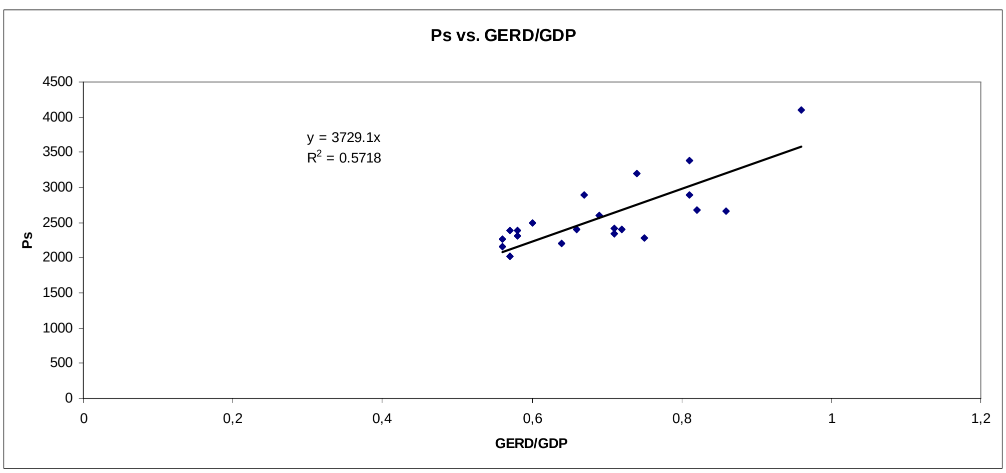

Fig. 3. Patent submissions versus GERD/GDP. This picture should be read from right to left.

4. Conclusions

We can observe two highly worrying tendencies to decrease in patent activity till 2004/2005, both in patent submissions and patents issued. Although the two declining tendencies were reversed in 2005/2006 but both of the quantities did not reach their levels of 1990.

Two clear sub-periods can be observed within the period under analysis:

5. 1990 - 2004/2005 – decline and
6. 2005/2006 - 2010 – growth.

Also, very worrying are decreasing tendencies referring to R&D expenditures. GERD (in constant prices) showed a tendency to decline till 2002. The GERD/GDP coefficient was declining to 2002 too, and afterwards it stabilized at a very low level. GERD started to slowly increase in 2003 but the GERD/GDP ratio – not earlier than in 2008.

Here two sub-periods are seen, too. They are as follows:

7. 1990 – 2002 – decrease with fluctuations at the end, and
8. 2003 - 2010 - stabilization and growth.

We can then say that, in the first sub-period, the declining GERD (in absolute and relative values) pulled down patent submissions and patents issued. Afterwards, in the second sub-period, growing GERD pulled up both submissions and patents. However, the two later quantities began to increase not at once but after three years. So, they react to changes in GERD with a certain delay.

The estimated econometric models confirm that the relation between patent submissions and R&D expenditures is positive and strong. The elasticity is 0.80 or even more. These findings seem to confirm that the mechanism described here in the section 2 works in reality. Therefore, one can say that the Griliches's model has found confirmation in Poland being a country in transition.

References

GUS (1996-2012). Yearbooks of 'Science and technology in Poland'. Warsaw: Central Statistical Office.
OECD (2012). Main science and technology indicators. http://stats.oecd.org:80/index.
Jasinski, A. H. (2003). Postep techniczny w okresie transformacji. Warszawa: PAN.
Rosegger, G. (1986). The economics of production and innovation: An industrial perspective. Oxford: Pergamon Press.
Griliches, Z. (1990). Patent statistics as economic indicators: A survey. 'Journal of Economic Literature', Vol. XXVIII, December, 1661-707.
Pavitt, K. (1996). Patent uses and abuses. Brighton: SPRU, University of Sussex.
Stoneman, P. (1987). The economic analysis of technology policy. Oxford: Clarendon Press.
Enders, W. (2010). Applied econometrics: Time-series. Chichester: Wiley.
Jasinski, A. H., & Manikowski, A., (2010): Innowacyjnosc polskiej gospodarki w latach 1989-2007. In Jasinski, A. H. (ed). Innowacyjnosc polskiej gospodarki w okresie transformacji: Wybrane aspekty. Warszawa: The Warsaw University Press.

Appendix A.

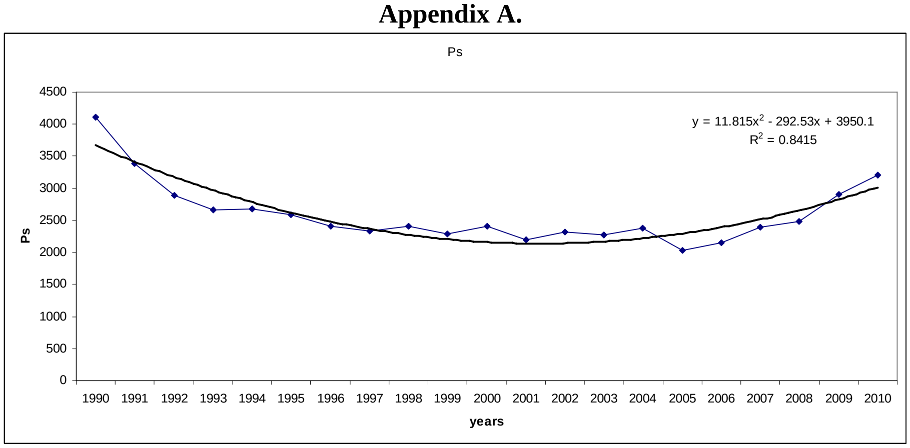

Fig. 4. Domestic patent submissions in Poland, 1990-2010

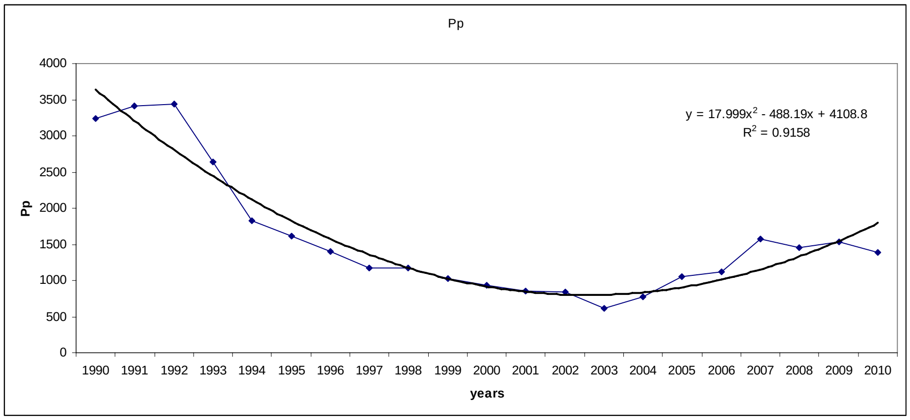

Figure 5. Domestic patents issued in Poland, 1990-2010

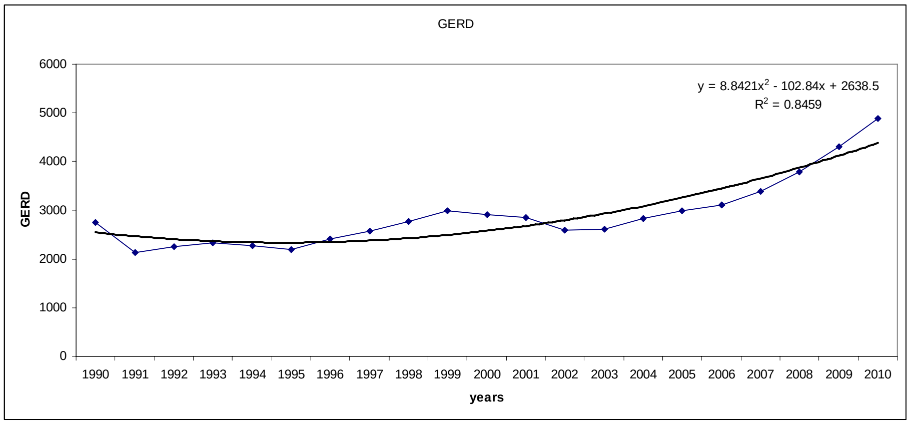

Figure 6. GERD in constant prices (in $mln) in Poland, 1990-2010

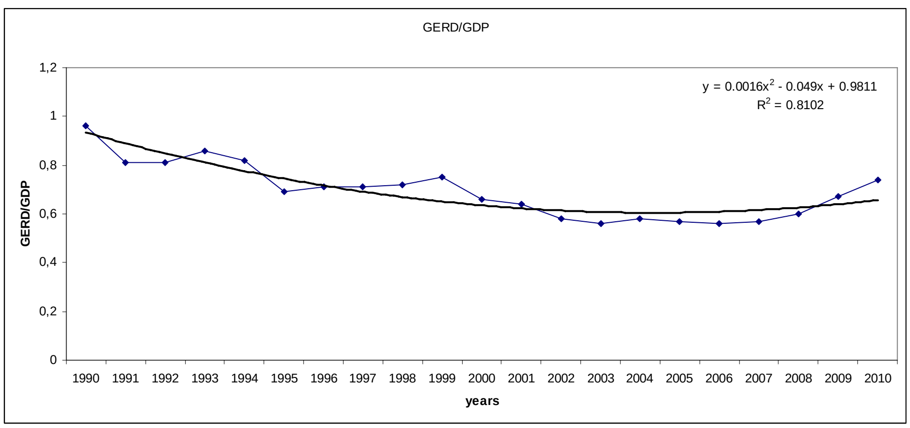

Figure 7. The GERD/GDP ratio in Poland, 1990-2010

Appendix B.

Table 2. Report on estimates of parameters in model (2)

Vector Error Correction Estimates
Sample(adjusted): 1991 2010
Included observations: 20 after adjusting Endpoints
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1	
Ps(-1)	1.000000	
GERD(-1)	-0.742070	
	(0.17127)	
	[-4.33287]	
C	-484.9364	
Error Correction:	**D(Ps)**	**D(GERD)**
CointEq1	-0.346602	-0.237076
	(0.04947)	(0.07452)
	[-7.00619]	[-3.18119]
C	-45.10000	106.7370
	(32.1426)	(48.4207)
	[-1.40312]	[2.20437]
R-squared	0.731690	0.359885
Adj. R-squared	0.716784	0.324323
Sum sq. Resids	371933.7	844042.8
S.E. equation	143.7462	216.5439
F-statistic	49.08663	10.11996
Log likelihood	-126.6862	-134.8810
Akaike AIC	12.86862	13.68810
Schwarz S.C.	12.96819	13.78768
Mean dependent	-45.10000	106.7370
S.D. dependent	270.1081	263.4368
Determinant Residua Covariance		9.05E+08
Log Likelihood		-260.8830
Log Likelihood (d.f. adjusted)		-262.9902
Akaike Information Criteria		26.89902
Schwarz Criteria		27.19774

Table 3. Report on estimates of parameters in model (4)

Victor Error Correction Estimates
Sample(adjusted): 1991 2010
Included observations: 20 after adjusting Endpoints
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1	
LOG(Ps(-1))	1.000000	
LOG(GERD(-1))	-0.844367	
	(0.25281)	
	[-3.33995]	
C	-1.146698	
Error Correction:	D(LOG(Ps))	D(LOG(GERD))
CointEq1	-0.296068	-0.166168
	(0.05691)	(0.07502)
	[-5.20253]	[-2.21499]
C	-0.012406	0.028795
	(0.01362)	(0.01795)
	[-0.91103]	[1.60405]
R-squared	0.600589	0.214186
Adj. R-squared	0.578399	0.170529
Sum sq. resids	0.066756	0.116009
S.E. equation	0.060899	0.080280
F-statistic	27.06630	4.906174
Log likelihood	28.64564	23.11947
Akaike AIC	-2.664564	-2.111947
Schwarz SC	-2.564990	-2.012374
Mean dependent	-0.012406	0.028795
S.D. dependent	0.093790	0.088147
Determinant Residua Covariance		2.31E-05
Log Likelihood		52.08808
Log Likelihood (d.f. adjusted)		49.98087
Akaike Information Criteria		-4.398087
Schwarz Criteria		-4.099367

Table 4. Report on estimates of parameters in model (6)

Dependent Variable: PS
Metod: Least Squares
Sample: 1990 2010
Included observations: 21

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GERD/GDP	3729.108	98.48065	37.86640	0.0000

R-squared	0.571771	Mean dependent var	2595.048
Adjusted R-squared	0.571771	S.D. dependent var	484.4457
S.E. of regression	317.0174	Akaike info criterion	14.40224
Sum squared resid	2010001.	Schwarz criterion	14.45198
Log likelihood	-150.2235	Durbin-Watson stat	0.644149

DESIGNING AND IMPLEMENTING A SCIENCE, TECHNOLOGY AND INNOVATION (STI) POLICY IN A DEVELOPING COUNTRY CONTEXT: RECENT EXPERIENCE FROM NIGERIA

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Abstract
The objective of this paper is to assess the various Nigeria's S&T policies between 1986 and 2003 in terms of policy design and implementation or service delivery using the pillars of good democratic governance: Transparency, accountability, equity and inclusiveness. Unfortunately, the record of previous S&T policy design in Nigeria has been dismal as concretely reflected by the incidences and prevalence of their failure in the attainment of their respective goals. This is largely due to non adherence to the democratic principles epitomized by the Top-bottom methodological approach adopted. Hence the need for a new democratic paradigm as exemplified in the Nigeria's current STI policy.

Keywords: Democratic governance; Paradigm; Methodological; Top-bottom, design.

1. Introduction

The vital role of STI in socio-economic development is acknowledged the world over. The more industrialized countries of the world applied S&T to develop their economies. China, South Korea, India, Malaysia and Singapore, and a few other countries, followed suit and have also successfully applied STI to transform their economies [1]. The very rapid economic transformation that has taken place in the Republic of Korea, for example, in contrast to Nigeria is generally attributed to their greater success in acquiring and using the knowledge and innovation based on STI. Thus it is becoming increasingly clear that developments in STI are not only important determinants of country's level of development but also enhance its international competitiveness. In this context, it is deserving to explore options open for developing countries in formulating and implementing effective STI policies at the national level. Thus it is imperative for developing countries like Nigeria to embrace STI as a vital tool for accelerating their socio-economic development [2]. This is very essential in that, just as STI are not an end in themselves but a means to an end, so is STI policy. A realistic STI policy for any country should, therefore, reflect the key role that STI will play in bringing about the rapid socioeconomic development and subsequent realisation of self reliance.

To accomplish the task in this paper, it is organized into eight sections. Section one is the introduction. Sections two provides historical explanations to the past and present efforts at S&T development in Nigeria. Sections three and four highlight the objectives of the new STI policy and the adopted methodology for the review process respectively. Section five assesses how the pillars of governance are employed in the pursuit of STI policy in Nigeria. Section six examines the outputs of the review exercise. Section seven focuses on the challenges to the review process and how they were resolved. The final section, eight, serves as the concluding notes.

2. Past efforts at S&T Development in Nigeria

In Nigeria, various Governments, since independence, have shown interest and increasing appreciation and understanding of the critical role of S&T on the national political and socio-economic development programmes. They have accordingly at various times made efforts at constructing structures and formulating policies to mobilize S&T for rapid national development [3], with limited success. These efforts, which started with the establishment of few research centres, initially mainly in agriculture and medicine, led to the creation of Nigeria Council for Science and Technology (NCST) in 1970, the National Science and Technology Development Agency (NSTDA) in 1977, a full-fledged Ministry, the Federal Ministry of Science and Technology (FMST) in 1979, and with it the five

Federal Universities of Technology which were aimed at ensuring the harnessing of Nigeria's vast potentials in the area of S&T and entrench the culture of S&T. However the FMST experienced serious historical reformation identifiable in various merging, demerging and total dissolution before it was re-established in 1993 with its present status.

The further realisation and appreciation of the role of S&T in national socio-economic development underscored the production of first National Science and Technology Policy in the country in 1986 which was designed to create harmony in the pursuit of knowledge about the environment through research and development (R&D). The Ministry, after about 10 years of its implementation, saw the need to incorporate new developments areas in S&T and then review the 1986 S&T policy in 1997 [4]. The 1997 S&T policy was aimed at creating an independent, integrated and self-sustaining economy with major attention paid to the coordination and management of S&T system, sectoral developments, collaboration and funding. It however failed to address the institutional frameworks that should foster interaction among the various elements of the National System of Innovation (NSI). The FMST then reviewed the 1997 national S&T policy and reformulated a new, bolder and more effective policy (2001) that is in tune with the rapid, unprecedented global changes (disruptions) in Science and Technology [3]. More importantly, advances in S&T with wide applications, such as innovations in ICT and Internet applications as well as emerging trends in biotechnology, nanotechnology among others make it imperative for Nigeria to review the S&T policy in 2003. Like the previous policies, the 2003 S&T policy was not without its inadequacies. The 'policy' document was seen as a compendium of key S&T sub-sectoral policies, voluminous, and inadequately to attend to the issue of S&T culture and the harmonisation of S&T policy with other socioeconomic policies.

2.1 Present efforts at S&T Development

Despite the previous efforts at policy formulation, the national S&T system continues to suffer major weaknesses and constraints as reflected by the general lack of visible impacts arising from weak integration of S&T into national development planning processes, ineffective policy instruments, poor R&D coordination and inadequate funding among others [5]. Moreover, competitive pressures on the national economy are enormous. For instance, the global trade environment which is dominated by rapidly emerging technologies and processes, and technical barriers to trade and globalisation as well as climate change and its consequences are gradually becoming threatening to Nigerian enterprises and pose both opportunities and risks to its economic development. Local enterprises can still be competitive in the global trade environment with enhanced innovation and scientific content in their operations in all areas. In this regard, Nigeria as a matter of urgency has to make urgent policy decisions to harness STI in the development process. Therefore there is the need to develop a more concise, robust and workable STI policy given these challenges. The realisation of this fact and against the governmental vision which drives the passion for science and technology-led development underscored the need for a definitive and prescriptive National STI policy to define the vision, goals, objectives and priorities for investment in STI. Besides, such a policy must be able to commit government, public and private sector organizations, as well as science and technology institutions to effectively collaborate and network in order to attain the maximum utilisation of the country's endowments for wealth creation and employment generation through research and development (R&D) and innovation. It is against this background that the development of the New National Science, Technology and Innovation Policy was initiated with the following objectives.

3. Objective s of the New National STI Policy

The major goal is to develop and build a strong STI capability and capacity needed to actualise the Vision 20:2020 Economic Transformation Blueprint [6] of the country and evolve a comprehensive and modern economy by the year 2020. Other Objectives are to:

i. Facilitate the acquisition of knowledge to adapt, utilise, replicate and diffuse technologies for the growth of SMEs, agricultural development, food security, power generation and poverty reduction;
ii. Support the establishment and strengthening of organisations, institutions and structures for effective coordination and management of STI activities within a virile national innovation system;
iii. Encourage and promote creation of innovative enterprises utilising Nigeria's indigenous knowledge and technology to produce marketable goods and services;
iv. Support mechanisms to harness, promote, commercialise and diffuse locally developed technologies for the production of globally competitive goods and service that intensively utilises Nigeria's raw materials;

v. Facilitate and support the creation and maintenance of up-to-date, reliable and accessible database on Nigeria's STI resources and activities;
vi. Promote activities for effective STI communication and inculcation of STI culture in Nigerians;
vii. Create and sustain reliable mechanisms for adequate funding of STI activities in Nigeria; and
viii. initiate, support and strengthen strategic bilateral and multilateral co-operations in scientific, technological and innovation activities across all sectors of the economy [4].

To show the readiness of the government in this regard, the Honourable Minister for Science and Technology, in the foreword to the New STI policy asserted that "obviously if Nigeria, given its natural endowments, is to successfully transform its economy and take her rightful place in the comity of nations, S&T and its integration in national socio-economic development processes must be accorded the highest priority" [7]. The Federal Government equally emphasised its strong dedication and sincerity towards its implementation as could be discerned from the statement of commitment by Mr. President which reinforced that of the Honourable Minister that "we are going to run our economy based on Science and Technology….because nowhere in this World now that you can move your economy without science and technology. For the next 4 years we will emphasize so much on S&T because we have no choice, without that we are just dreaming…" [8] Without doubt, this era began the enlivenment of the government's strategic development agenda in line with the global best practices which has been hitherto considerably faded in the country for some time now. This is specifically depicted by the transformation agenda of President Goodluck Jonathan Administration which calls for a fundamental and far-reaching reorientation of the Nigerian State towards holistic socio-economic development in the framework of Vision 20:2020 [4].

4. Methodology for Accomplishing the Objectives

In the context of the above, the new National Science, Technology and Innovation Policy was crafted and adopted. Specifically, taken cue from the developed countries of the world, the country adopted an all-inclusive participatory approach and explored a thorough and holistic method to incorporate "innovation" in the revised S&T policy. The objective of the review process was to:

i. examine the adequacy of the various components of the existing S&T policy;
ii. evaluate the relevance of the policy to national socio-economic needs and visions;
iii. assess the effectiveness of existing and proposed institutional frameworks for adequate and consistent policy implementation;
iv. conduct desk top survey / review of best practices on policy documents in selected countries;
v. examine the adequacy of the various components of the draft STI policy; and
vi. come up with a revised policy on STI incorporating new and emerging issues in global S&T policy making.

In achieving the set objectives, the review team which consists of experts and consultants

i. carried out critical analyses of S&T policies of over twenty-five (25) countries;
ii. analyzed some existing and related documents particularly that of the Economic Summit Group and the 2005 Nigeria/UNESCO STI reform project;
iii. created platforms for national discourses on the extant S&T policy under review;
iv. actively engaged various stakeholders within the Nigeria's NSI as well as experts and development partners at different meetings to peruse the draft STI policy; and
v. make necessary inputs before the submission of the final draft.

The reviewers decided to embark on this approach in view of the consensus of the opinions that the Nigerian state is yet to come to terms with fundamental issues that produce good public policy on the one hand, and how governance can transform good public policy, STI policy in this case, into good service delivery. This is against the background that, the pillars of good governance such as transparency, responsibility, accountability, participation and responsiveness to the needs of the people are yet to occupy a pride of place in the country. It is as a result of this that this paper x-rays how these elements, hitherto neglected in the previous STI policy formulation efforts, now embedded in the utilised approach, are expected to shape STI policies to the extent that they can make or mar the achievements of the expected goals.

5. STI Policy and the pillars of good governance in Nigeria

Public policy within the matrix of which STI policy falls, can be seen as an intention, pronouncement, a general plan or action adopted by a government to solve a social problem, counter a threat, deal with a given circumstance or pursue an objective in a given state [9]. Public policy consists of all the authoritative public decisions that governments make as the outputs of the political system [10]. Essentially, the objective of policy is to make the response of the agency or body in charge predictable and fair to all affected citizens [11]. But, given the general belief that the higher the quality of "governance" in a country, the higher the quality of public policy, and given the commitments of various governments in Nigeria to good governance, it is incredible that most of the public policies formulated have not been able to adequately solve the problems at which they were directed. Specifically, in terms of policy formulation and implementation or service delivery in Nigeria, the level of participation is very low as government employs top-down approach [12]. The situation is that government plans for the people and not with the people, this makes public policies to be hardly based on consensus contrary to what exists in a normal setting [13]. Unfortunately, the record of STI policy formulation in Nigeria has been dismal as concretely reflected by the incidences and prevalence of its failure to be utilised and implemented in most of the sectors of the economy.

Transparency and accountability are two interrelated and complementary concepts in the understanding of governance. They are described as crucial elements of good governance [14]. The concept of transparency has been described as openness in government activities and entails the features of freedom of expression on the part of the citizenry, willingness on the part of the government to receive and evaluate new ideas, easy access to information and leadership, among other [15]. Central to the concept of transparency in public sectors is not only fiscal transparency but equally involves accurate and reliable data. The importance of transparency is underscored by its role in enhancing good governance and accountability as well as in eliciting confidence in government by the people [13]. However, this seems to be seriously lacking in the past STI and other public policies' formulation in Nigeria as epitomized by the elitist nature of public policies which remove from the citizens any sense of belonging and loyalty required for effective implementation.

In addition, accountability requires government decision-makers to sincerely and dedicatedly adhere to the provisions and implementation of the policy as well as be accountable to the citizens for their actions. In fact, Ezeani [16] reinstated this when he argued that public accountability is no doubt central to modern government and public administration while Okolie [17], in the same vein, described public accountability and transparency as cardinal ingredients of democratic governance. Examining the element of accountability in relation to public policy in Nigeria, Dibie [18] observed that "lack of accountability, corruption, and inadequate enforcement of ethics and code of conduct are three major problems confronting public policy-making and implementation in Nigeria". The veracity of these problems was put into perspective by Anifowose and Seteolu [19] when they posited that 'the public domain has emerged into a contested terrain of factions of the dominant elite that subordinate national interest to narrow, self-centred interest.

As a result of inefficiency and ineffectiveness, the country's development problems have become many and complex and they cover several areas such as the economy, agriculture, technology, social structures, political structure, and physical and human resource development [20]. This has been due largely to corruption, unfavourable political environment, and citizens' attitude to work and implementation of policies among others. This has further worsened the country's relatively poor economic performance and its persistence in spite of its resources endowment and tremendous potentials.

More importantly, if the elements of equity and inclusiveness are considered in the country over the years, one will experience serious disappointment. This is because ordinarily, the main goal of any society is to achieve socio-economic development through policy that is expected to translate to improved quality of life and equity in production and distribution of goods and services among the citizens [20]. Unfortunately, in Nigeria, social justice for majority of Nigerians still remains elusive, and the use of absolute numbers in stark poverty overwhelms whatever gains may be apparent for some. This problem can be attributed to the political economy of public policy in the country as exemplified by the often non inclusion of majority of the people who have stake in the policy in its formulation process. Dibie [18] showed that "all too often, governments pursue socioeconomic, political and technological policies that benefit those in government at the expense of the people as shown by the practice during the military era. Such policies not only concentrate the benefits of growth in few hands but in many cases, actually retard economic growth".

All these challenges informed the adoption of the bottom-up and the democratic approaches adopted by the National Centre for Technology Management (NACTEM), an agency of the Federal Ministry of Science and Technology

(FMST) Nigeria that was commissioned to handle the review exercise on behalf of the Ministry. These approaches avail all the stakeholders of effective participation in the policy process which assisted in solving the problem associated with lack of equity and noninclussiveness. The approaches also created the needed awareness on the revised Policy thereby remove the difficulty that could arise from the issues of non accountability and transparency in policy formulation. This is so in that all and sundry who are likely to be affected were involved from the genesis of the mutation of the idea of the review and are actually involved and engaged. This then provides opportunity for actors to articulate their views in the new policy, created a platform for interaction with other stakeholders in all sectors especially, the Implementers and further opportunity for stakeholders to know the impact of policy on business practice / activities. This eventually facilitated Joint ownership of the revised policy and resolves the problem posed by the previous top-down approach which hindered effective utilisation and implementation of the past policies by all stakeholders in the country.

6. Outputs of the present effort

Unlike previous STI documents the concept of innovation is strongly welded into the new policy to apply S&T for achieving social and economic objectives. This has come from the realization worldwide that technologies that come from science and technology are able to bring about desired changes only when they are fully integrated into local systems and practices which may not necessarily have emerged from S&T. The document also provides a realistic appraisal of what is feasible within the medium to long term framework including its larger scope and coordination, to reflect federalism; and content, which is now more focused, realistic, and reform based. The policy goals, objectives, approaches and mechanisms to achieve the contents of the policy, have taken account of, among other things, investment in infrastructure, education and training, research and development and science acculturation in the explicitly designed implementation framework hitherto neglected. Very significantly is the provision of elaborate funding mechanism as well as the governance system and strategies for achieving appropriate fund for STI activities. This underscores the recent approval of the ***National Research and Innovation Fund (NRIF),*** a product of the new national STI policy and allocation of significant fraction of the National Lottery Fund as special R&D and Innovation fund in Nigeria. This is against the backdrop of the available data as revealed by the ASTII R&D survey [23] and Nigeria's Science, Technology and Innovation Indicators [24] Survey that the country's Gross Expenditure on R&D as percentage of GDP is comparatively low ditto for the available R&D personnel, and researchers as a percentage of R&D personnel, output from the educational and research institutions in relation to the performance in science and technology (S&T) is also very low in spite of the proliferation of these institutions due to weak institutional and infrastructural supports coupled with inadequate STI human capital resulting from poor reward system, poor incentives to innovate, inefficient Intellectual Property (IP) management mechanism and effective capacity building programmes among others. All these have constituted major weakness and hindrance to effective operation of the national S&T system. This is also corroborated by that of the World Bank [25] which shows that Nigeria is not ranked among the top 72 countries in research and development expenditures as it spends less than US$100 million in R&D. Thus the new STI policy dedicatedly articulates, with appropriate strategies and implementation plan, R&D priority setting, S&T administration and governance, elaborate and reliable funding mechanism, collaborative engagement of stakeholders (Development Partners and Public-Private-Partnership) in a strategic manner, and venture capital development with specific focus on Technology Entrepreneurship and R&D Commercialisation for achieving Nigeria's transformation agenda and future scientific, technological and innovation engagements/ advancement.

7. Challenges to the Review Process and how they were resolved

For a very long time now, Nigeria has realised the need for utilising S&T as a critical tool for enhanced sustainable development. Specifically, since the commencement of the current democratic dispensation, the country is in the process of building a national consensus for innovation as one of the pillars of its development strategy. Nigeria advanced the design and implementation of innovation policy. These advances, as can be deciphered from our earlier discussions in this paper, can be summarised in three major points viz: rising consensus for innovation as a driver of development and a policy paradigm shift; adopting bottom-up approach to increase public support for S&T policy; systematic organisation of financial resources for innovation; and consistent institutional strengthening and policy learning. The process of making these advances is not without some challenges. The major key challenge for building knowledge-based competitive advantages for the country is how to preserve the dynamic consistency of the policy and ensure capitalisation of efforts. This is explained by identifying some lines of actions which contribute to the process of institutional strengthening of STI policy in Nigeria, with a special focus on three key policy areas:

7.1 Ensuring long term commitment to support Science, Technology and Innovation (STI)
The experience of Nigeria shows that it is necessary to ensure continuity to investments in support of innovation. How to ensure government and other stakeholders' commitment and supports to uninterrupted financial interventions in support of STI particularly the innovation side; continuity and a systemic approach that are required in the generation of scientific, technological and production capabilities constituted a big challenge. This remained so given the fact that the country needs to strengthen the institutional capacity to manage innovation policy, capitalising on recent efforts and identifying steps to improve the current policy design and to support long term commitment for innovation among other issues. However, different policy dialogues in which different stakeholders were given opportunity to discuss the design and implementation of the policy provided situation for agreement on the establishment of the National Research and Innovation Council (NRIC), an institutional mechanism put in place to provide strong leadership, effective coordination and adequate resources for all STI activities within the National Innovation System of Nigeria. This is with a view to ensuring a long term commitment to STI financing. Another related challenge is how to establish by law the role of the NRIC and adherence to the contents of the policy document remains a fundamental step in the legitimisation of the institution, among others created and the STI policy as a policy of the country, and not as a Government preference. This is critically required in that clarifying the relationship of the NRIC with other STI institutional structures at all levels of government (National Council on Science, Technology and Innovation (NCSTI) and State Science, Technology and Innovation Council (SSTIC)) is a desirable step to increase policy accountability and to ensure a more bottom-up policy strategy building and the commitment towards policy implementation. In solving this challenge, the President of the Federal Republic of Nigeria is made Chairman of NRIC while the Federal Ministry of Science and Technology (FMST) will serve as the secretariat. For efficiency, the Council shall consist all Ministers from the cognate ministries. All these are supported by the development of appropriate legal framework to institutionalise long term commitment (backed by legislation) to the implementation of STI policy within the context of national economic development.

Other challenge is how to empower state actors in designing and implementing STI policy. There is a need to clarify institutional responsibilities at the state level in the area of innovation and to differentiate between strategy building and executive functions, and to clarify the relationship between the FMST and the state ministries On this note, NACETEM, as an institutional referent for STI policy in the country and within the framework of her mandates, has been providing critical knowledge support and sound policy advice on STI issues to actualise the country's development agenda. The agency is currently embarking on STI revolution epitomized by the provision of workable and steady assistance to state governments and public/private institutions in Nigeria on STI-related issues. This is with a view to empowering these actors in the process of designing and implementing STI policy for sustainable development.

Co-ordination among governmental bodies is crucial for ensuring policy sustainability and implementation. The existing relationship between some institutions and structures in Nigeria constitute serious hindrance to policy design, implementation and sustainability. This stems from the way such institutions were established. For instance, the way the Ministry of science and technology is established in some state constitute major problem in collaboration, networking, partnership and coordination of S&T policies and activities. Private sector and other STI stakeholders are equally affected as there is no effective institutionalised collaboration and partnership. In ameliorating this problem, the review process emphasised increased participatory approach in strategy building, integrating all encompassing bottom-up diagnosis and mobilise private sector and other stakeholder's commitment towards the STI policy for improved policy effectiveness.

7.2 Improving the mechanisms for the allocation of resources
There is widespread recognition that in Nigeria the process of resource allocation to innovation is too bureaucratic and that it needs to be improved to become more effective. Currently the mechanisms for the assignment of resources to innovation are decided the same way with respect to other ministries during the approval process of the national budget. This limits the margin of manoeuvre of STI related agencies and confers an excessive power to the Ministry of Finance on the allocation of resources to STI activities. The proposal of the legal framework and law which establishes the NRIC and other STI governance structures will ensure that the fund responds to its primary function of representing a continuous source of financing for STI activities as well as transparency and accountability. It helps to build strong and trustful institutions and feasible co-ordination mechanism for resource allocation.

7.3 Addressing the co-ordination failure and improving the governance structure.

One of the major drawbacks of the previous policies is the lack of clear administrative procedures and strong institutional infrastructure for policy management. A major challenge for the country and the review process is how to ensure an effective designing and implementation of STI policy by addressing the co-ordination failure and improving the governance structure. The existence of similar programmes administered by different ministries and agencies and unnecessarily compromise of benefits due to bureaucratic competition constitute serious problems and drawbacks. The new STI policy in its attempt to resolve this problem, opted for creating an appropriate organisational environment of complementary relationships and network that minimises frictions and institutional lapses for coherence coordination, management, promotion and application of STI in production of goods and delivery services for socio-economic development [4].

Having recognised that a prerequisite for effective STI policy is the political commitment at the highest legislative and executive levels of government regarding legal recognition and adequate budgetary allocations in support of STI activities, efforts was made to involve both the Senate and House Committees on STI at the formulation stage of the review process. This commitment stem from the need to provide the policy with an adequate governance structure for budget allocation and national STI priority setting by the house committees and the National Council on Science, Technology and Innovation (NCSTI) respectively. In fact, to be effective NCSTI is not only formally entrusted with defining national priorities and ensuring inter-ministerial, inter-departmental and inter-agencies' co-ordination of S&T policy orientation and national support programmes, it is empowered to effectively collate and disseminate annual reports of achievement from all pubic STI agencies and facilitate active interaction/brokerage among government, industry and national research system [4].

In Nigeria, there is a chronic lack of capacities to manage STI policy. Therefore, capacity building for policy management and institutional strengthening is critically required. It is important to establish procedures for policy dialogue between the different levels of governments in order to favour trust building, the generation of common routines and working practices, and to favour policy learning [21]. It is in this respect that NACETEM becomes strategic to the sustainable development of Nigeria. More importantly, it should be stressed that the review team was able to resolve some of the challenges to the exercise by leveraging on the advent of democratic governance in the country. This democratic governance has generated high expectations about the role and capacity of the Civil Society Organisations (CSOs) to strengthen governance and foster democratic deepening [22]. Regardless of any conception about the ability of CSOs in engaging state structures[3], they continue to make significant contributions to national and state development processes through policy advocacy, no matter how small. Thus the process of review leverage on this tool to influence and lobby the decisions of policy makers, by discussing problems directly with them, delivering messages through the media, and strengthening the ability of local, state and national organizations who support our STI viewpoint to advocate. This assisted in the listing of the STI policy review issue to be discussed during meetings with policy maker and the final approval of the policy by the Federal Executive Council of Nigeria.

8. Conclusion

[3] The civil society sector is said to be considerably weak and most CSOs have not developed a strategic approach for engaging State structures. Traditionally, the relationship between civil society and governments were strained and CSOs were generally unable to leverage influence on the State. This situation of disengagement has made CSOs unable to contribute significantly to governance processes (WACSI, 2011). In addition, The CIVICUS Civil Society Index which carries out comprehensive assessments of the state of civil society also indicates that, civil society's policy impact remains inadequate in many West African countries. The index highlights that, the most common barriers to policy influencing are internal to CSOs. It points to weak policy influencing skills as a core constraint. Also, actors have cited the closed nature of the policy environment as an impediment to their participation, and that policy makers do not see the sector as credible (See details in www.civicusbeta.org/new/content/e-CIVICUS377.htm?07c23fc490fb56da28db023ad7e04d9d... (accessed on 20 August, 2010)).

There is no doubt about the fact that the current approach to review exercise effectively recognised the existed lacuna in the previous attempts at STI policy review and fostered a flawless engagement of STI with the desired transformation. This is exemplified by the review process's recognition of the weaknesses of the nation's past STI policy formulation process and that of its system of innovation characterised by lack of required interactions and collaboration among its key actors. Consequently, the review process and the emerged policy document strengthened structures for the coordination, promotion, and management of interactions within the system through the involvement of all actors and stakeholders at every stages of the process. This is capable of motivating the stakeholders and ensuring their compliance to, and utilisation of the contents of the policy for sustainable development. This is in view of the fact that a system that encourages interactions among individuals, businesses firms and government in its operations permeate and affect every strata of the population. As policymakers and administrators continue to struggle with how to best design and implement STI policy that ensure unflinching commitment to support innovation; improving the mechanisms for the allocation of resources; and addressing the hitherto policy formulation and co-ordination failure, and improving the governance structure, they might consider the adopted approach described in this paper. Readers should keep in mind that the lessons are derived from our experiences as members of the policy review team. It is hoped that this experiences of how these were achieved despite the various challenges vis-a-vis the role of political re-engineering and advocacy will be useful to other developing countries around the world for adoption.

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References

[1] Siyanbola, W.O. (2008), 'Isn't there a better way? The case for a paradigm shift in R&D in Nigeria', *Paper presented at Federal Polytechnic*, 17 June, Nekede.

[2] Siyanbola, W.O. (2011) Progress Report On Nigeria's National Science, Technology And Innovation Policy. A paper Presented at: The Experts' meeting on Science, Technology and Innovation Policy Review, May 10th.

[3] Okongwu, D.A. (2007), '25 years of Technology Transfer as a Policy of State: 1981-2006', in Okongwu, D.A. (ed.), *Fifty Years of Technology Transfer in Nigeria: 1956-2006: The Quest for Technological Capability and Economic Transformation*, Abuja: Ucheakonam Foundation Nig. Ltd.

[4] Nigeria National Science, Technology and Innovation Policy (STI) (2011)

[5] National Centre for Technology Management (NACETEM) (2011), 'Assessment of Research and Development (R&D) Productivity in Nigerian Universities', *A Policy Project Report*, NACETEM, Ile-Ife, Nigeria.

[6] Nigeria Vision 20:2020 document.

[7] Ewa, I.O.B (2012) Universities As Key Subsectorial Interfaces For Economic Transformation Through Science And Technology. A paper presented at the 28th Convocation of the University of Portharcourt.

[8] Jonathan, G. E (2011) Statement of Commitment in Nigeria National Science, Technology and Innovation Policy (STI) (2011)

[9] Akindele, S. T and Olaopa, O. R (1997) Public policy and its environment: A theoretical review of core issues. The Nigerian Journal of Politics and Public Policy (NJPPP) Vol. 1; Agagu, A. A (2001) "Public Policy and the Nigerian Public Administration" in Omotosho, F (ed) Contemporary Issues in Public Administration. Lagos, Bolabay Publication. Pp228-242. ; Agagu, A.A (2010 Governance and Public Policy in Nigeria in Omotoso, F; Agagu, A.A and Abegunde, O (Eds) *Governance, Politics and Policies in Nigeria: An Essay in Honour of Professor Dipo Kolawole.* Benin Republic. Editions SONOU d'Afrique. Pp38-53.

[10] Almond, G. A. Powell (Jr), G.B. Dalton, R.J. and Strom, K. (1996) (eds) *Comparative Politics Today: A World View.* New York: Pearson Longman.

[11] Edwards III, George, C. (1980) Implementing Public Policy. Washington, D.C. Congressional Quarterly Press.; Edward (2004) cited in Agagu, A.A (2010 Governance and Public Policy in Nigeria in Omotoso, F; Agagu, A.A and Abegunde, O (Eds) *Governance, Politics and Policies in Nigeria: An Essay in Honour of Professor Dipo Kolawole.* Benin Republic. Editions SONOU d'Afrique. Pp38-53.

[12] Adelusi–Adeluyi, J. A (1990) constraints to policy formulation and implementation in Nigeria Natural Institute, kuru.

[13] Agagu, A.A (2010 Governance and Public Policy in Nigeria in Omotoso, F; Agagu, A.A and Abegunde, O (Eds) *Governance, Politics and Policies in Nigeria: An Essay in Honour of Professor Dipo Kolawole.* Benin Republic. Editions SONOU d'Afrique. Pp38-53.

[14] Bello-Imam, I.B and Obadan, M.I (2004) Democratic Governance and Development Management in Nigerias Fourth Republic 1999-2003: The Prologue. In Bello-Imama, I.B and Obadan, M.I (Eds) Democratic Governance and Development Management in Nigerias Fourth Republic 1999-2003, Ibadan, Center for Local Government and Rural Development Studies (CLGARDS), Pp1-14.

[15] Obadan, M. I. (2003a), "Globalization and Africa: Issues, Challenges and Policies". A Paper Prepared for delivery at the University of Addis Ababa Ethiopia under the aegis of the World Bank Institute, July; Obadan, M. I. (2003b), "Globalization and Policy Challenges". A Paper Presented at the NCEMA Workshop on Macroeconomic Management, Organised for CBN Staff in Lagos, February – March.; Obadan, M. I. (2003c), National Development Planning and Budgeting in Nigeria (Lagos: Broadway Press Ltd.).; Obadan, M. I. (2003d), "Towards Nigeria's Sustainable Debt strategy". Chapter 8 in Okonjo – Iweala, N, C. C. Soludo and M. Muhtar, ed. The Debt Trap. Towards a Sustainable Debt Strategy in Nigeria (Trenton, New Jersey: Africa World Press, Inc.)

[16] Ezeani, E.O (2003) Public accountability in Nigeria: perspectives and issues. Enugu. Academi Pub. Co.

[17] Okolie, A.M (2003) as cited in Agagu, A.A (2010 Governance and Public Policy in Nigeria in Omotoso, F; Agagu, A.A and Abegunde, O (Eds) *Governance, Politics and Policies in Nigeria: An Essay in Honour of Professor Dipo Kolawole.* Benin Republic. Editions SONOU d'Afrique. Pp38-53.

[18] Dibie, R. (2000) *Understanding Public Policy in Nigeria: A Twenty-First Century Approach.* Lagos: Mbeyi and Associates (Nig) Ltd.

[19] Anifowose, and Seteolu, (2004) "The State, Politics and Economy Under Obasanjo" *UNILAG Journal of Politics* 1 (1) December.

[20] Ajakaiye, O. and Akinbinu, B. (2000), Strategic Issues in Nigerian Development in a Globalizing and Liberalizing World, Ibadan: NISER.

[21] Inter-American Development Bank (IDB) (2010) Strengthening Institutional Capacities for Innovation Policy Design and Implementation in Chile. Social Sector Science and Technology Division. Technical Notes, No. IDB-TN-130.

[22] Olaopa, O.R. (2004) Public enlightenment Programmes: An effective mechanism for citizens' mobilization, political consciousness and participation in Nigeria" In Aborisade, O.A And Aransi, I.O. (Eds) (2004) State and Local Government in Nigeria: the Changing Scene, Charlotte, N.C., U.S.A., Catawba Publishing Company, Pp.197-215.; West Africa Civil Society Institute (WACSI) in collaboration with the Local Government and Public Service Reform Initiative, of the Open Society Institute (LGI-OSI) and the Open Society Initiative for West Africa (OSIWA) (2011) Policy Engagement and Advocacy Training for CSOs in Ghana. Call for Application. Accra, Ghana.

[23] African Science, Technology and Innovation Initiatives (ASTII) R&D survey.

[24] Nigeria's Science, Technology and Innovation Indicators (2010) Report of 2006/07 R&D Survey (1st edition).

[25] World Bank (2011) *World Development Indicators* based on 2010 data as of 1 July 2011.

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Agriculture beyond food: a scientific program exploring the potential of biomass

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Abstract

The Agriculture Beyond Food Program is a collaborative scientific program between Indonesia and The Netherlands focusing on the bio based economy. The program was initiated at the request of the ministries concerned, and jointly designed by Dutch and Indonesian scientists. The program accommodates around 20 PhD and post-docs from both Indonesia and The Netherlands.

Keywords: *Bio-economy; bio fuel; biomass; Jatropha; Oil palm*

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1. Agriculture for food

1. Plants are at the base of all life. By converting solar energy into sugars and biomass, plants form the basic food source for men and animals. By first collecting plants, followed by cultivating plants and breeding new, improved varieties, men succeeded to enormously increase the efficiency of plant production. Increased labor productivity now allows a single farmer to produce for many fellow people, freeing time for other activities and setting off economic developments. In the Netherlands, for example, only 2 % of all economically active labor forces are involved in agriculture, whereas in Ethiopia still 80% of all labor forces are involved in agriculture (FAOstat). In addition, the land productivity has increased enormously and allows us to produce enough food to feed the world on the limited area suitable for agricultural production. This increase is beyond the expectation of many. At the end of the 18th century, Thomas Malthus warned for the first time for a population outgrowing the agricultural production capacity. He pointed out that where population tends to growth at a logarithmic scale, food supply will increase linearly at most, with the inevitable consequence that food supplies will run short. He stated that '…*The most enthusiastic speculator cannot suppose a greater increase than this…*' [1]. Yet reality proved different, and food supply kept pace with population growth. Almost hundred years later, the club of Rome launched the report 'Limits of Growth'[2]. They conclude in a neo-Malthusians way that '… *If the present growth trends in world population, industrialization, pollution, food production, and resource depletion continue unchanged, the limits to growth on this planet will be reached sometime within the next one hundred years…*'. Yet once again food production grew faster than anticipated. Per caput, more food is available to date than it was a century ago. Apparently the agricultural productivity is very flexible, and man is creative in finding solutions for immediate threatening problems. The increase in productivity is characterized by discontinuities as exemplified by the productivity of the Indonesian paddies. Technological innovations like the use of fertilizers, the availability of new plant varieties, irrigation, mechanization and biocides, combined with institutional rearrangements, are at the base of these discontinuities. There are, however, considerable regional differences. In Sub Saharan Africa (excluding South Africa) and some Asian regions, the food availability is substantially lower than the global average. Yet the overall picture is that food

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production kept pace with population growth in the past. It is difficult to extrapolate these developments to the future, where we probably need to feed 9 billion people by 2050. Some publications show that there are good perspectives to reach this goal if we keep innovating our production systems and, especially, increase the sustainability of the systems [3]. Yet new challenges await us. Plants have always been used for non-food purposes. To date, however, the fast emerging bio-economy rapidly increased the need for biomass, urging us to shape the Agriculture Beyond Food.

2. Agriculture beyond food

The recent exciting scientific developments in plant sciences increase the potential of plants enormously. These new possibilities respond to the growing demand for agriculture products by modern society, generally referred to as the bio-based economy. This bio-based economy is a term which encapsulates a vision of a future society no longer wholly dependent on fossil fuels for energy and industrial raw materials. The concept also responds to a variety of global trends, such as growing global demand for healthy and sufficient food, produced according to ethically acceptable environmental standards, and growing risks of food-related diseases, posing a challenge to researchers from many disciplines to find solutions to make a bio-based economy possible. It is also a challenge for governments to design policies that enable adoption of techniques supporting developments toward such a future society. In the bio-based economy, agriculture will expand widely beyond its main current function: the production of food. The challenge to date is to develop a sustainable agriculture beyond food.

Discussion of the future of bio-based products and the competition fight between food and fuel is now exploding at various places in the world among scientists, politicians and policy makers and in the media. The new developments in the field of bio-fuels are considered both a threat in terms of sustainability, and an exciting new option for agricultural development. Many developing countries, well suited for the production of biomass for the bio-based economy, faces the challenge to sustainably profit from economic possibilities of the renewed interest in biomass. It is very important to be aware of the consequences of this major development of agriculture. Scientific insight in possibilities and opportunities, threats and limitations are needed to judge the future of an agriculture beyond food. It is imperative that in this discussion technical, social, economic and legal scientists cooperate and that the whole production chain is considered. That is the challenge of the current scientific program: stimulating scientist from different disciplines to collaborate and jointly find answers to the many questions posed by the bio-based economy. In this program Dutch and Indonesian scientists and policy makers joined forces to outline sustainable concepts for the bio-economy.

3. Three programs

Under the Agriculture Beyond Food umbrella, three scientific programs are launched. In each program, a number of Indonesian and Dutch PhD-students, post-docs and supervisors collaborate. The programs concerned are the following [4].

3.1. Jarak: The commodization of an alternative biofuel crop in Indonesia.

Jatropha promises much: clean non-fossil diesel fuel, and new income sources in marginal areas that will grow the crop. The promise has already inspired millions of dollars of realized investment in *jatropha* plantations and many plans for more announces in newspapers and conferences. In only a few years an ordinary hedge plant, *jarak pagar* in Indonesian, has turned into the valuable commodity for energy production: *jathropha*. What caused this process of rapid commoditization? What are the environmental requirements and consequences? How can local producers and laborers benefit from the prospective profits? World-wide, proponents of *jatropha* as a source of biofuel claim a high level of social and ecological sustainability for this crop. Indonesian national policy began promoting *jatropha* in 2006. The research cluster JARAK aims to build a scientific knowledge base by which these claims may be objectively addressed. It will do this by tracing the rise of *jatropha* as a commercial crop in Indonesia, assessing the assumptions underlying its introduction, investigating the production potentials in Indonesian circumstances, and identifying how legislation, governance and policy concerning *jatropha* can be supportive for local producers' livelihoods.

3.2. *Sliding from greasy lands: Migration flows and forest transformation caused by oil palm expansion in Riau and Berau*

Indonesia has made significant investments in energy crop production (mostly oil palm), to a large extent in response to an increasing global demand for edible oil and ingredients for soap, cosmetics and paint. The demand for palm oil for biofuel applications was recently added to the overall market demand for oil palm products. The establishment of oil palm plantations is often mentioned as the main driver behind land use change and deforestation, peat land degradation and forest fires. This has put Indonesia among the top three largest emitters of greenhouse gases in the world [5].

The research component presented here takes an integrated approach to look at the consequences of the rapid expansion of oil palm plantations for sustainable development and – more specifically - rural development planning. Three different perspectives (i.e. the people, the planet and the profit perspective) are integrated:

- The local government/institutional perspective focuses on the planning (profit) aspects, as local governments need to earn part of their development budget themselves.
- The environmental perspective (planet) looks at how indirect effects of oil palm plantations are accelerating forest transformation.
- The response mechanisms of local and non-local people, who try to make a living in areas where large and small scale oil palm plantations is expanding.

As such this research component aims to contribute to a clear understanding of the indirect effects of oil palm expansion. By understanding the underlying dynamics at work in forest transitions (the coping and adaptive strategies of people) we aim to contribute to supporting the national and local policy processes and to ensure that local communities become major beneficiaries of GOI's plans for establishment of forest and oil palm plantations on 'degraded' forest lands. The analysis made here may also provide opportunities to define degraded lands more specifically, as secondary forest patches may not necessarily be a degraded area. It may be (and often is) claimed and used by local communities. These insights provide good potential to look into the opportunity cost of avoided deforestation and forest degradation (REDD), as an alternative source of income rewarding forest conservation.

3.3. *Breakthroughs in biofuels: Mobile Technology for Biodiesel Production from Indonesian Resources*

The research project concerns the development of a local/community-scale biodiesel industry and waste products thereof in Central/South Kalimantan area to

- Stimulate the local economy and particularly local agricultural activities,
- Prevent further degradation of the environment and particularly that of sensitive peatlands,
- Reduce the chances of forest fires leading to haze problems throughout South East Asia,
- Stimulate the transition of Indonesia into a biobased economy, and
- Reduce the Indonesian dependency of fossil resources like crude oil.

By means of

- Use of (purified) Pure Plant Oils from local resources (rubber seed oil, palm oil, and possibly in the near future also *Jatropha* oil),

- Development of mobile biodiesel technology using acid/base catalysts as well as home-made lipases (e.g. using enzymes extracted from germinating *Jatropha Curcas* seeds) in highly integrated reactor/separator devices using methanol or locally produced bio-ethanol,
- Development of technology for the valorization of protein by-products with an emphasis on livestock feed and biofertilizer to improve the soil structure and reduce dependency of expensive fertilizers,
- Development of models for mobile processing units for multiple products (with limited shelf-live and/or optimal harvesting moment) and multiple end products to optimize production capacity,
- A local economic resource development (LERD) program, establishment of a framework and concrete action plan for all stakeholders involved in the introduction of new technology including local government planners, small entrepreneurs and NGO"s and creating a conducive environment.

4. Beyond scientific interest

Agriculture Beyond Food aims to explore and exploit the potential of biomass, indicating that, besides scientifically interesting, topics should have impact on a social economic and/or policy level. *Impact* is a key-word. To reach that goal, scientists must collaborate closely with industry, social organizations and policy makers. The program participated is several match-making events to inform economic and social partners about the program and to identify possible partners for future collaboration. As such, the program fits the triple helix philosophy very well. In addition, collaboration with other regional partners is welcomed, both from the SEA as the EU region. The authors are convinced that in a joint effort, the potential of biomass can be exploited fully in a sustainable way to the benefit of society.

References

2. Malthus, T. (1878). An Essay on the Principle of Population. London, printed for J. Johnson in st. Paul's churchyard.
3. Meadows, D. H., D. l. Meadows, J. Randers, W. W. Behrens III (1972). The Limits to Growth. Universe Books, New York.
4. Koning, N.B.J, M.K. Van Ittersum, G.A. Becx, M.A.J.S. van Boekel, W.A. Brandenburg, J.A. van den Broek, J. Goudriaan, G. Van Hofwegen, R.A. Jongeneel, J.B. Schiere, M. Smies, 2008. Long-term global availability of food: continued abundance or new scarcity? NJAS 55, 229-292.
5. See http://www.nwo.nl/nwohome.nsf/pages/NWOA_7LAJVJ_Eng
6. Trines, E., N. Höhne, M. Jung, M. Skutsch, A. Petsonk, G. Silva-Chavez, P. Smith, G.-J. Nabuurs, P. Verweij and B. Schlamadinger, 2006. Integrating agriculture, forestry and other land-use in future climate regimes. Bilthoven: the Netherlands Programme on Scientific Assessment and Policy Analysis (WAB).

ASSET EVALUATION OF THE BRANDS OF TECHNOLOGY PARKS OPERATIONG IN THE STATE OF STATE OF RIO GRANDE DO SUL, BRAZIL

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Abstract
The objective of this study is to analyze the behavior of BrandAsset® Valuator indicators for brands of Technology Parks operating in the State of Rio Grande do Sul, Brazil, as well as to measure the reputation attributes according to the seven dimensions proposed by RepTrak™. The survey target public was entrepreneurs with companies situated in the parks (Tecnosinos, Tecnopuc and Valetec). This work is oriented to study the TECNOSINOS, TECNOPUC and VALETEC brands, which are characterized as being in operation in the State of Rio Grande do Sul and for already having established companies.

The selected technology parks are equivalent in the infrastructural quality afforded to companies and the professional training of their researchers. The differentiation of the parks is founded on branding, a term defined for the aim of this study as the set of activities with the objective of improving perfection and effectuation of brand management for the purpose of creating a competitive edge against rivals, strengthening the brand. (KELLER and MACHADO, 2006).

The methodological procedures used are characterized as exploratory and conclusive research carried out with a quantitative approach and statistical analysis of a descriptive nature. The theoretical framework was based on authors who are specialists in brand evaluation models, such as Aaker (1998 and 2001), Gerzema and Lebar (2009), and the Reputation Institute's RepTrak™ model.

The results indicated that in all aspects studied, the TECNOPUC brand obtained better positioning in relation to the TECNOSINOS and VALETEC brands, there is a certain balance between the brand value perceived by respondents about the parks, with TECNOPUC taking a a slight advantage. Hence, we can infer that one reason for this could be attributed to the dynamic and positive work environment that reflects in the perceived image, notably measured by the RepTrak™ indicator, as the best workplace in relation to other parks. Moreover, with less impact, but also relevant, TECNOPUC stood out because of the following key factors: innovation, performance and leadership. The brands rated as active in the mass market, TECNOSINOS and VALETEC, presented as predominant characteristics, respectively, workplace and innovation. On completion of this study, we point out that, although the data used were derived from quantitative research carried out using the BrandAsset® Valuator model, we sought to avoid subjective interpretations. To this end, we used the RepTrak™ model to support the analyses and interpretations. This offered subsidies to arguments to the extent that the statistical analysis was repeated as a means of confirming the results obtained.

Keywords: Innovation, Technology Parks, Branding, Brand Evaluation, BrandAsset® Valuator.

1. INTRODUCTION

We live in a society of knowledge and information, characterized by a new source of economic wealth: innovation. According to the Organization for Economic Cooperation and Development (OECD), innovation is the implementation of a substantially improved product, asset or service, or even a new process, marketing method or organizational method in business practices the organization and external relations. Along that same line, innovation, according to Plonski (2005), is the process of putting a new idea into practice, and having it succeed and produce beneficial social and economic effects.

For Zen and Hauser (2005), this new paradigm, called the Society of Knowledge, makes innovation and technology diffusion key elements for development, and brings to the regions the need to meet the challenges and seize opportunities for competitive insertion. According to Plonski (2005), "technological innovation is increasingly being invoked as a strategy to redeem companies, regions and nations of their chronic economic woes and to promote their development". The author further feels this is why, since the 1990s, the implementation of effective policies to stimulate technological innovation has become one of the foundational axes of the OECD performance (which currently includes 34 countries committed to a pluralist democracy and market economy).

Seeking regional development, public officials have adopted a strategy to support the construction of innovation habitats, defined as environments for practical innovation and technological development designed by providing appropriate infrastructure and synergy between government, business community and academia. The innovation habitats may comprise technology-based incubators, business condominiums, technology parks and hubs, and technopolis programs (ZEN and HAUSER, 2005).

Therefore, this study aims to analyze the behavior of BrandAsset® Valuator indicators for brands of Technology Parks operating in the state of Rio Grande do Sul, as well as to measure the attributes of the reputation according to the seven dimensions proposed by RepTrak™, with the survey target public being entrepreneurs with businesses in the parks (Valetec, Tecnosinos and Tecnopuc). As such, the survey was structured in three sections. In the first part, the literature relevant to the technology parks in the State of Rio Grande do Sul, their brands and the brand valuation models used in this work was examined. That was followed by the methodological procedures, and lastly, the evaluated results were analyzed.

2. TECHNOLOGY PARKS

The Technology Park was conceived by the National Association of Entities Promoting Innovative Enterprises (ANPROTEC) as a science- and technology-based industrial complex, in which all production is the result of studies and projects developed in research and development (R&D) centers. It is also an enterprise aimed at promoting a culture of innovation and competitiveness in the community, as well as an increase in business training based on the transfer of intellectual capital and technology, with the objective of increasing the production of wealth (SPOLIDORO and AUDY, 2008).

2.1 TECHNOLOGY PARKS IN THE STATE OF RIO GRANDE DO SUL

The emergence of technology parks in Rio Grande do Sul was due largely to the PAT (Technopolis Porto Alegre) Program. Launched in 1995, the PAT was created focusing on local and regional development through articulated actions among nine government representative institutions (the State Government of Rio Grande do Sul and Porto Alegre City Council, the Program coordinators), academia (Federal University of Rio Grande do Sul - UFRGS, Pontifical Catholic University of Rio Grande do Sul - PUCRS and Vale do Rio dos Sinos University - UNISINOS), workers (Central Worker's Union- CUT), business community (Federation of Trade and Services of Rio Grande do Sul – Federasul, and the Federation of Industries of Rio Grande do Sul - FIERGS) and the civil society (Brazilian Service to Support Micro and Small Companies - SEBRAE). In effect, these partners have been investing in the development of an entrepreneurial culture in their institutions and have

acted strongly to consolidate suitable environments for innovation (ZEN and HAUSER, 2005). According to Southern Brazilian Network of Business Incubators and Science Parks (REGINP)2, in 2011, the region featured fourteen technology parks, with three being operational, two under construction and nine in project, as shown in Table 1.

Table 1 – Technology Parks in the State of Rio Grande do Sul

Name	Stage of Development	Institution of origin	City
TECNOPUC – PUCRS Scientific and Technology Park	Operational	PUCRS	Porto Alegre
TECNOSINOS – São Leopoldo Technology Park	Operational	UNISINOS	São Leopoldo
VALETEC – Sinos Valley Technology Park	Operational	FEEVALE	Campo Bom
TRINO PARK – Caxias do Sul Computing Hub Technology Park	Under implementation	UCS	Caxias do Sul
CECan – Canoas Entrepreneurship Centre and Technology Park	Under implementation	UNILASALLE	Canoas
PTU – Ulbra Technology Park	In project	ULBRA	Canoas
Parque da UFRGS – UFRGS Scientific and Technology Park	In project	UFRGS	Porto Alegre
Parque Cientec – Science and Technology Foundation	In project	SCT	Porto Alegre
UPFTEC – Passo Fundo University	In project	UPF	Passo Fundo
IPTEC – Ijuí Technology Hub	In project	UNIJUÍ	Ijuí
UNISC – Santa Cruz do Sul University	In project	UNISC	Santa Cruz do Sul
INOVATES – UNIVATES Technology Innovation Center	In project	UNIVATES	Lajeado
UFSM – Santa Maria Federal University	In project	UFSM	Santa Maria
Southern Zone Technology Park	In project	Insufficient information on the issue	Insufficient information on the issue

Source: Compiled by the author according to data made available by REGINP, 2011.

According to LOCUS magazine, march 2011 edition:

> Brazil is becoming an attraction hub for research centers of global companies. General Electric (GE), Dell, HP and Schlumberger are examples of such companies. They all either have installed or are installing research and development offices in technology parks in the country. The reason? Business opportunities that important sectors such as oil and gas (O&G) generate for multinationals, the closeness
> that the parks promote between the productive sector and academia, and access to skilled manual labor (DIAS, 2011, p.22).

Thus, multinationals and other domestic companies come in search of an innovative environment. On the other side are the universities, which offer, in addition to the academic atmosphere with cutting-edge research, skilled manual labor. Technology parks, in turn, play the role of mediator and manager in this university-industry partnership.

The regional context is characterized by the presence of three parks operating in the State of Rio Grande do Sul, each with a tendency to equate the services offered in technical and functional aspects. For this reason, the study and evaluation of the assets of the brands of Technology Parks operating in the State of Rio Grande do Sul is justified as a differentiating factor for attracting businesses.

2.2 TECHNOLOGY PARKS AND THEIR BRANDS – THE BRAND AS A VALUABLE ASSET

The Technology Parks elected for this study in relation to their brands were chosen from the development stage of the enterprise. This work is directed to study the TECNOSINOS, TECNOPUC and VALETEC brands, which are characterized as being in operation in the State of Rio Grande do Sul and for already having established companies, as shown in Table 2.

Table 2 – Technology Park Brands operating in RS

BRAND	Beginning of activities	Place of origin	Reason for existing
TECNOSINOS Parque Tecnológico São Leopoldo	1999	São Leopoldo	*General Objective:* Tecnosinos aims to create the environment necessary for the implementation of technology-based companies, enabling their creation, growth and generation of added value, and impacting on Brazilian socioeconomic and environmental development.
TECNOPUC	2003	Porto Alegre	*Mission:* To create a community of interdisciplinary research and innovation through the collaboration between academia, businesses and government in order to increase the competitiveness of its players and improve the life quality of its communities. *Vision:* In 2010 TecnoPUC would be a national and international reference for the relevance of the brand research on innovation, promoting technical, economic and social development in the region.
VALETEC	2005	Campo Bom	*Vision*: Valetec's general objective is to promote actions that aim for the technological development of the region it is inserted, seeking regional integration, fostering entrepreneurship, and the creation and development of companies and research.

Source: Technological park websites: TECNOSINOS (www.tecnosinos.com.br), TECNOPUC (www.pucrs.br/agt/tecnopuc) and VALETEC (www.valetec.org.br). Accessed by the author on 07-07-2011.

The three technology parks operating in Rio Grande do Sul shown in Table 2 are equivalent in the infrastructural quality afforded to companies and the professional training of their researchers. The differentiation of the parks is founded on branding, a term defined as the set of activities with the objective of improving perfection and effectuation of brand management for the purpose of creating a competitive edge against rivals, strengthening the brand. (KELLER and MACHADO, 2006).

For Jungmann and Bonetti (2010), branding is the effort of constructing and managing a brand within the market. Its execution comprises marketing actions to position and disclose it. This way, the brand gains status and becomes part of the culture of a particular place, region, state or country.

In the business to consumer (B2C) – a term that defines the brand that relates directly with the final consumer – it becomes decisive in determining the purchase of a product or service by remitting to the information received from the marketing activities and prior shopping experiences. And in the business to business (B2B) relationship – a concept that defines the brands that provide services or manufacture products for other companies in order to gain strength from such partnership – the association of a company to another brand adds status and value (MOREIRA and NETO, 1998, HUTT and SPEH, 2002).

In this case, the brands are B2B for being a company that negotiates with the Technology Park, contrary to B2C. For Hutt and Speh (2002), being affiliated to a brand is a means to increase the potential of the type of enterprise that it is or would like to be. This way, according to Keller and Machado (2006), the brand is an extremely valuable asset to businesses as well, since it fulfills the purpose of identifying the product/service and offers legal protection to the organization through the approval of its registration. Upon obtaining a certificate of registration, the holder is entitled to the exclusive use of the brand throughout the country, and may prevent competitors, as well as request legal clarification from any individual or company that uses similar distinctive signs (such as logos, trademarks or packaging design) that might confuse consumers (JUNGMANN and BONETTI, 2010).

In the analysis of Aaker (2001, p.27), the strongest trademarks are those managed not only in terms of recall, recognition and familiarity (what the author calls a general awareness), but also in terms of strategic awareness. If managed through a consistent branding strategy, a brand that is legally protected and well-developed in the market will become a significant asset to the company. The objective o marketing should also be stressed, which is to:

> [...] create and attract value for consumers. Companies use their brands to build interest, esteem and respect. They know that when these attributes are deteriorating and consumers no longer trust the brand, loyalty decreases and people either stop buying or wait for incentives, such as price discounts, before they return (GERZEMA and LEBAR, 2009, p.15).

The brand, by establishing branding strategies combined with marketing, becomes a valuable asset capable of influencing consumer behavior. Also, if bought or sold, it provides the holder with the security of constant future income (KELLER and MACHADO, 2006).

Keller and Machado (2006) recall that in 1980 there was a “frenzy” of mergers and acquisitions. That period was marked by a demand from Wall Street investors for undervalued companies from which it was possible to make profits through investments or acquisitions of control. Among the primary assets, undervalued brands stood out because they were not accounted for on company balance sheets. On Wall Street there is an implicit belief that strong brands result in better performance of revenue and profits for companies, which in turn creates value for shareholders.

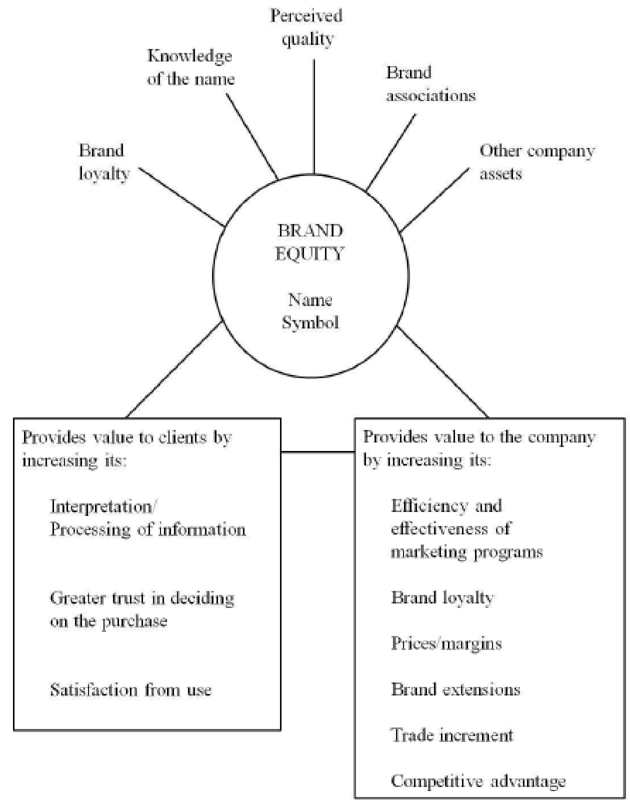
According to both Aaker (2001) and Keller and Machado (2006), as well as Gerzema and Lebar (2009), there is emphasis on the concept of brand together with the intangibility characteristic, with the need for management, for adding value to the product/service, despite being physically dissociated. According Gerzema and Lebar (2009), the value of a brand varies according to the value that the company attributes to intangible assets. Currently, they are significant factors in the performance of the company as a whole and of its market value, contributing much more than the value of sales and profits. (GERZEMA and LEBAR, 2009).

As with all intangible assets, the valuation of a brand is an inaccurate calculation, because, even today, the traditional accounting methods do not offer a precise formula to estimate the added value of intangibles to the value of the company. However, most accounting models recognize that brand names, logos and other intellectual property are part of the organization’s overall intangible value (GERZEMA and LEBAR, 2009). Also according to these authors, intangibles comprehend the estimated value of items such as brands, market position, operational advantages, proprietary process, franchise agreements, client lists, patents, copyrights and company reputation.

Given the importance of intangible assets, particularly of brands, for the organizations, our studies of brand equity – a term sometimes translated as “brand value” – concerns the intangible value attached to a company as a result of its successful efforts to establish a strong brand. Brand equity represents the attractiveness of a brand in the market and allows companies to charge premium prices for their products and services, thus contributing to an increased profit margin (GERZEMA and LEBAR, 2009). Moreover, it is a management model of brand equity proposed by Aaker (1998) that is universally used up to the present.

The author describes this model as a set of assets and liabilities linked to a brand, its name and its symbol, which adds to or subtracts from the value provided by a product or service to an organization and/or its clients. In practice, this approach can be summarized in five categories, as defined below and shown in Figure 1: (1) brand loyalty: the ability the consumer has to develop brand loyalty; (2) knowledge of the name: refers to the level of knowledge and familiarity with the brand or what it adds to the consumer; (3) perceived quality: when a brand has associated with it a perception of overall quality, in addition to technical specifications, that remit to the characteristics of the product/service (a determining factor for the practice of overpricing - Premium); 4) brand associations: refers to the brand positioning, be it through its slogans, characters or lifestyles; and (5) other company assets: represent other brand value assets, such as patents, trademarks, software, licensing, franchising, everything that creates competitive advantage and that is not covered in the previous items.

Figure 1 – Brand Equity.



Source: Aaker (1998, p.18).

In fulfilling its role in adding value to the consumer, brand equity also adds value to the company by:

> [...] generating marginal cash flow in at least six ways: 1st) it can highlight focus on programs to attract new clients or win back old ones; [...] 2nd) brand loyalty can be enhanced through the last four dimensions of brand equity; [...] 3rd) brand equity can usually provide higher margins by allowing both a premium price and a reduction in the use of promotions; [...] 4th) brand equity can provide a platform for growth via brand extensions; [...] 5th) brand equity can give new impetus to the distribution channel; [...] 6th) brand equity assets provide a competitive advantage that often represents a real barrier to competitors (AAKER, 1998, p. 17-18-19).

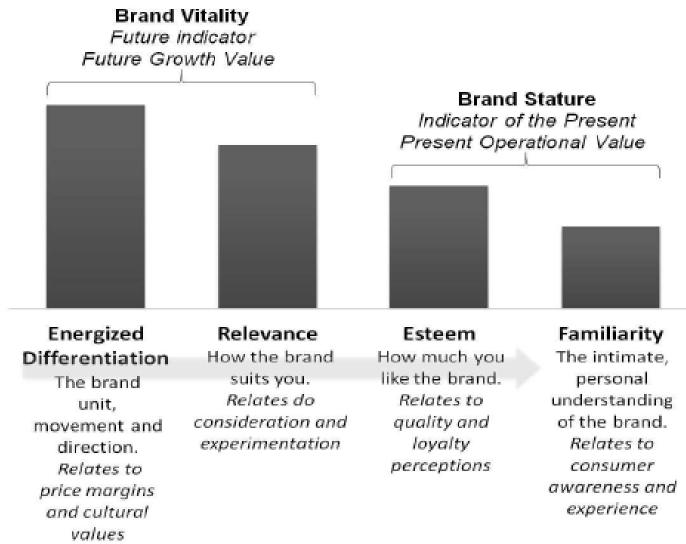
The concept of brand equity proposed by Aaker (1998) was used in this study, rather than the other models cited by other authors, because of an affinity with the BrandAsset® Valuator (BAV) evaluation model of the intangible assets, unique tool for the valuation of brands that has been used by Young & Rubicam4 for over 15 years, and RepTrak™, developed by the Reputation Institute5.

2.3 BRANDASSET® VALUATOR AND REPTRAK™: BRAND EVALUATION MODELS USED IN TECHNOLOGY PARKS OPERATING IN THE STATE OF RIO GRANDE DO SUL

In this study we applied the BrandAsset® Valuator (BAV) brand evaluation model in three technology parks operating in RS. The purpose of the models was to identify how much consumers know and value the brand by measuring its current value and its potential trend for the future. The BAV® is established from four pillars that allow to position and interpret the movement and the success of a brand. They are: differentiation, relevance, esteem and familiarity (GERZEMA and LEBAR, 2009).

In Figure 2 we present the structure of the four pillars of the BAV®, and we can verify that they are grouped into two sets to determine the vitality of the brand (energized differentiation and relevance) and brand stature (esteem and familiarity).

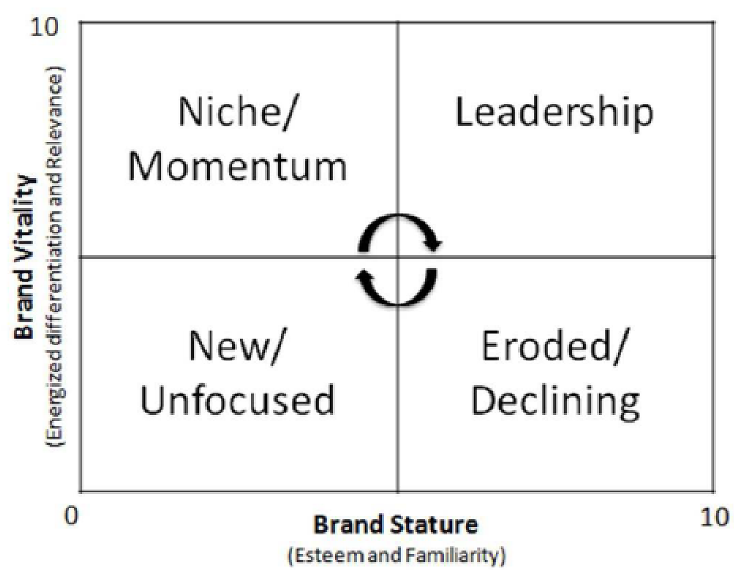
Figure 2 – Pillars of brand evaluation



Source: Gerzema e Lebar (2009, p.50).

These two measurements crossed make up the X and Y axes of a graph: the PowerGrid, under which we position the current status of the brand in the market (stature) in comparison to its future growth potential (vitality). In Figure 3 we show the quadrants where each brand is positioned at any given time, compared to other brands. Thus, the performance of the brands is mapped, plotting them in one of the quadrants that determine brand positioning in a very specific and precise fashion (GERZEMA and LEBAR, 2009).

Figure 3 – The BAV® PowerGrid.



Source: Gerzema e Lebar (2009, p.53) adapted by the author.

The BAV® model viewed in this way, in the PowerGrid quadrants, symbolizes the movement, fluidity and dynamism of the market, as well as what the brands are able or not able to provide it; as well as allowing to verify growth standards, health, decay or reputation over time. Gerzema and Lebar (2009, p. 55) state that by observing the

brands throughout their life cycle, we realize "the importance of having married strategies of brand development and business development. Lacking alignment, bubbles form".
Reputation, in turn, is a fragile and valuable attribute to the organization. The key to the success of its achievement is directly linked to the organizational capacity to convey credibility to consumers, and to understand the best possible way where it is deposited, taking into account the public look and perception (ROSA, 2006).
We also use the RepTrak™ model in this study to analyze the reputation of brands as the most valuable and lasting asset of an organization. This model is a tool, developed by Reputation Institute to measure corporate reputation. It is based on the theory that reputations are emotional attributes and attitudes developed by stakeholders (interested parties) in relation to organizations6. The model is comprised of a reputation across seven dimensions, as may be seen in Figure 4, and these are considered the key factors that most influence the company's reputation:

Figure 4 – Seven dimensions that evaluate reputation.

Source: Adapted from Reputation Institute (2011).

(1) Products/Services: the organization values its product/service and represents a differential for the consumer/client. (2) Innovation: the organization invests in innovation efforts. (3) Workplace: the organization provides a pleasant, healthy work environment. (4) Governance: the governance model is perceived by the public. (5) Citizenship: the organization contributes to society. (6) Leadership: the organization has the market leadership and in its sector of activity. (7) Performance: the organization's performance is perceived in a coherent and integrated fashion.
Having established the analysis variables, the following section covers the methodological procedures that subsidized this research.

3. METHODOLOGICAL PROCEDURES

The present study was based on the application of two methods: exploratory and conclusive research. The former was developed through the bibliographical findings with the objective of providing a general outlook about a particular fact (GIL, 1999). The latter was carried out through a quantitative approach and statistical analysis of a descriptive nature and was conceived with the purpose of assisting the decision maker determine, assess and select the best course of action in a particular situation (MALHOTRA, 2001).

To carry out this research, a formal Google Docs[7] electronic questionnaire was used, containing five structured, closed questions, with the first four being scalars from 1 to 10, and the last containing seven variables in the grid with scales from 1 to 5, adapted to each technological park brand. It was based on the Brand Equity indicators according to the following models: BrandAsset® Valuator – differentiation and relevance (brand vitality), esteem and familiarity (brand stature) – and RepTrak™ – products/services, innovation, workplace, governance, citizenship, leadership and performance, indicators which assess consumer behavior and reaction regarding brand attributes and reputation, as presented in Table 3.

Table 3 – Structured, closed questions

BRANDASSET® VALUATOR	
1	What is the differentiation grade for brand ..... ? Differentiation grade: how distinct it is from others in its market segment.
2	What is the relevance grade for brand ..... ? Relevance grade: how pertinent and important it is for the market.
3	As a consumer or potential consumer of brand ..... , what is your esteem grade towards it? Esteem grade: how much affection, consideration and respect do you hold towards it.
4	As a consumer or potential consumer of brand ..... , what is your familiarity grade towards it? Relevance grade: how pertinent and important it is for the market.
REPTRAK™	
5	Lastly, assess the seven dimensions below, considering brand ..... :
A	Products/services
B	Innovation
C	Workplace
D	Governance
E	Citizenship
F	Leadership
G	Performance

Source: Compiled by the author by adapting tools in the BrandAsset® Valuator from Young & Rubicam (Y&R) and RepTrak™ from Reputation Institute.

For a pertinent evaluation of the three brands' intangible assets, a work plan divided into three phases was designed: previous notice, data collection and result analysis. In the first stage, a previous written notice document was sent to the parks' businessmen, the research population in this case, which informed about the period it would take place and clarified the research objectives, as well as requesting their collaboration. According to Malhotra (2001, p. 358) "such notification increases the response rates by the general public by reducing the surprise factor and uncertainty, and creates an atmosphere of greater cooperation".

In the data collection phase, the questionnaire was forwarded via email to 205 businessmen (72 Tecnopuc, 71 Tecnosinos and 62 Valetec) between August 17 and 26, 2011, which produced a return of 94 valid questionnaires (38 Tecnopuc, 35 Tecnosinos and 21 Valetec) representing 46% of total response considering the percentage average per park (53% Tecnopuc, 49% Tecnosinos and 34% Valetec). In view of the need to establish an intentional statistic sample that would correspond to all parks, a response rate of 30% was elected, which, according to Malhotra (2001), represents a good rate. Thus, the other questionnaires considered as valid were discarded according to the order of return, from the last sent to the one before last, and then on, until reaching the number proposed by the 30% rate for each park, as shown in Table 4.

Table 4 – Delimitation of the sample number per park

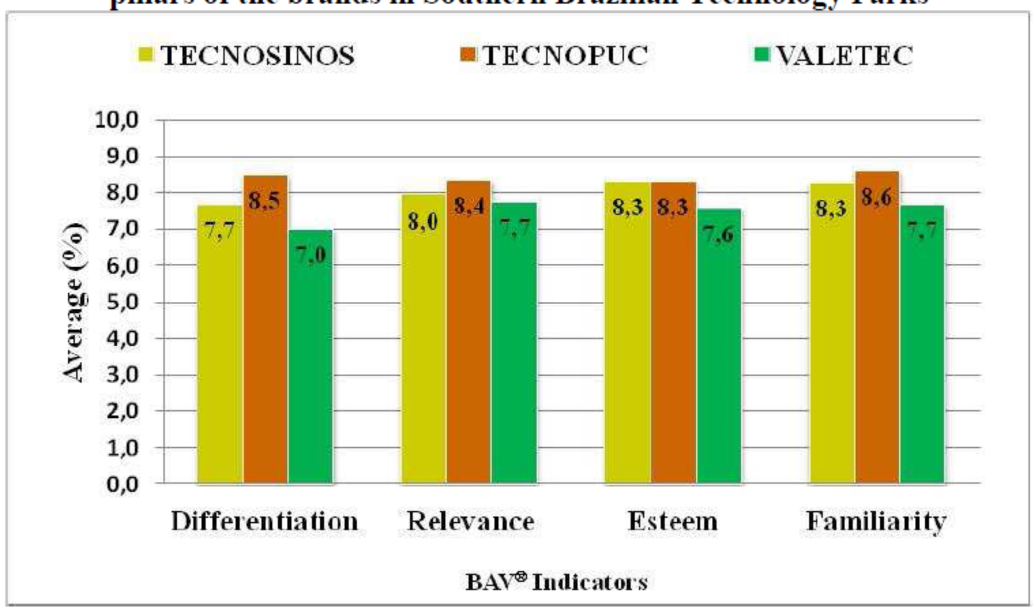
TECHNOLOGICAL PARK	Nr. OF QUEST. SENT	Nr. OF QUEST. REPLIED	TOTAL RETURN %	Nr. OF QUEST. DISCARDED	Nr. OF QUEST. VALID FOR A SAMPLE OF 30%
TECNOPUC	72	38	53%	16	22
TECNOSINOS	71	35	49%	14	21
VALETEC	62	21	34%	2	19
TOTAL	**205**	**94**	**46%**	**33**	**62**

Source: Compiled by the author from the data collected.

4. RESULTS

The following is the analysis and interpretation of data considering the methodology presented in section 3 and the theoretical framework. The objective of this research was to analyze the behavior of the BrandAsset® Valuator (BAV) indicators for the chosen brands, as well as how to measure the attributes of reputation according to the seven dimensions proposed by the RepTrak™. It should be noted that the three brands in this study are concerned with the legal protection of their names and figures, for the TECNOPUC and VALETEC brands had their registry requests granted by the National Institute of Industrial Property (INPI) in 2009 and 2010, respectively. The TECNOSINOS brand is waiting for its request to be approved by the federal government. The first stage of processing of the data consisted of a descriptive statistical analysis of the BAV® indicators in order to understand the behavior on the brands being studied.

Chart 1 - Statistical analysis of the four BrandAsset® Valuator pillars of the brands in Southern Brazilian Technology Parks



Source: The author (2011).

As noted in Chart 1, in a range of 0.0 to 10.0, with regard to differentiation, the TECNOPUC brand with an average of 8.5%, is considered distinctive in relation to the others in its market segment, compared with TECNOSINOS with 7.7% and VALETEC with 7.0%. On that threshold, it has a greater capacity to attract loyalty and the power to establish margins (GERZEMA and LEBAR, 2009), since it is features a higher distinctive grade in relation to the existing regional brands in its market segment, and therefore the differentiation is a very important factor for the future of the brand. This way, it is of no use for the brand to have a high relevance, for it will be paralyzed and easily confused – for not differentiating itself – among its competitors if does not offer a differential to consumers.

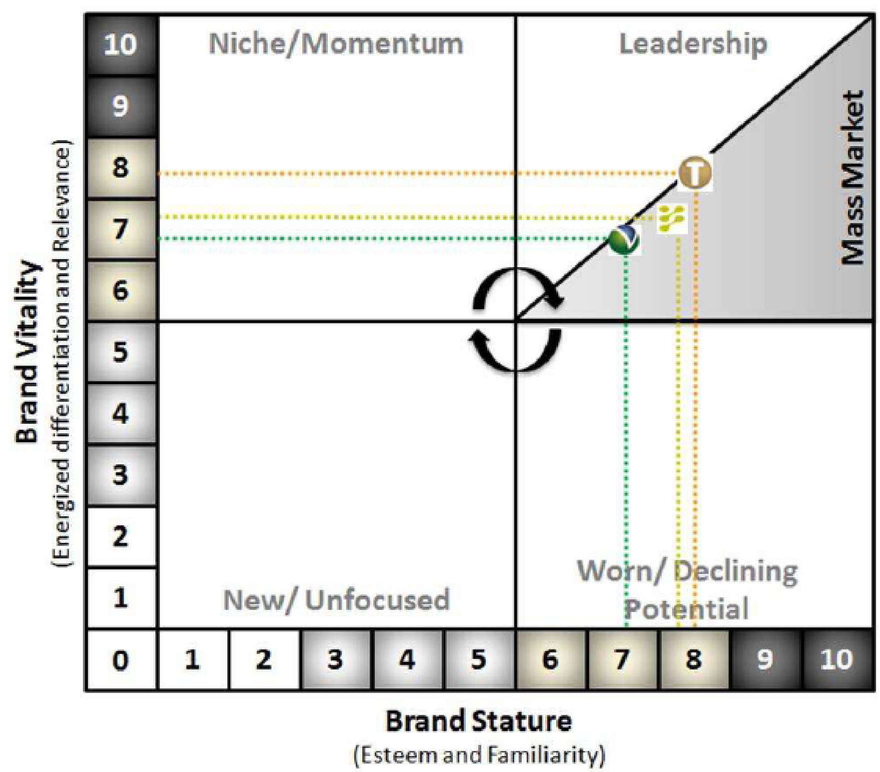
The relevance, in turn, indicates how much the brand is perceived as appropriate for clients and the market. The rates of 8.4% and 8.0%, respectively, for TECNOPUC and TECNOSINOS show that these brands have a higher potential for market penetration in relation to 7.7% for VALETEC, because they have better results for the relevance indicator, since with no pertinence and importance the brand is weakened and becomes hungry for clients in the market where it operates.

Regarding esteem, both TECNOSINOS and TECHNOPUC brands, with rates of8.3%, and VALETEC, with an average of 7.6% that is lower than the others, reveal the consideration and respect that the client has in relation to the brands. Therefore, the higher the result for the esteem indicator, the greater the affection, admiration and perceived quality by the client.

Familiarity indicates the degree of public awareness in relation to the brand, assuming it knows the brand exists and identifies how much it is present in its life. For this reason, this constitutes the indicator with the most significant rates for all brands: TECNOPUC (8.6%), TECNOSINOS (8.3%) and VALETEC (7.7%). Thus, as familiarity increases, a higher number of consumers believe they know what the brand represents. In effect, the brands studied feature strength in the esteem and familiarity dimensions, which, according Gerzema and Lebar (2009), means that all have been able to establish in the hearts and minds of clients.

In the next stage, we plot the scores of brands to measure the vitality, which considers the value of the future growth of the brand, and the stature, which shows the present operational value of the brand with the purpose of drawing a holistic picture of its situation with the performance indicators that consider the future. As stated by Gerzema and Lebar (2009, p. 55), "as we plot the PowerGrids, we can literally study and trace the evolution of the brands through their movements".

Figure 5 – *BrandAsset® Valuator PowerGrid* indicators for the brands in Southern Brazilian Technology Parks.



Source: The author (2011).

The ordinate axis shows the brand vitality (the higher up the graph, the greater its vitality); the abscissa axis represents brand stature (the further to the right, the greater its stature). Both are concurrently constituted from the average between the differentiation and relevance indicators, and the average between the esteem and familiarity indicators. According to Gerzema and Lebar (2009), when positioned in the leadership quadrant, the

brands are simply irresistible. In this study, it can be observed that the three brands are in this position: thus, we perceive that, with time, they managed to build both brand vitality and stature.

However, as shown in Figure 5, the VALETEC and TECNOSINOS brands remained closer to the diagonal line that runs through the leadership half quadrant, which means that their stature – 7.6 and 8.3 respectively – turned out to be greater than their vitality – equivalent to 7.4 and 7.8. The brands that enjoy this position generally hold the leadership in their category, but their ability to establish a pricing policy and generate future growth is dropping. This can be observed mainly in relation to the results obtained by the TECNOSINOS brand, which show a greater distancing between the two rates.

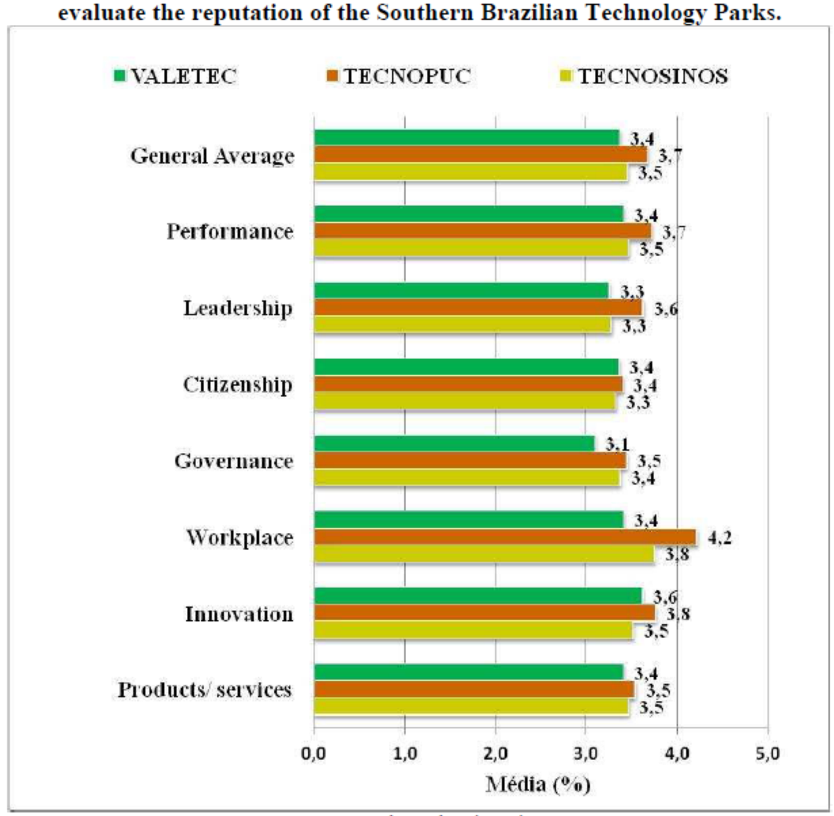
Although the VALETEC brand may still feature a vitality of 7.4%, with the differentiation rate (7.0%) lower than the relevance rate (7.7%), its uniqueness is disappearing and the price or convenience are becoming the main factors that determine client choice. In this position, the VALETEC brand tends to be more rational than creative (GERZEMA and LEBAR, 2009).

Regarding the TECNOPUC brand, with higher vitality, for presenting high levels of differentiation (8.5%) and relevance (8.4%), as well as a greater degree of equivalence. These levels show that the brand stands out for clients in a significant fashion. In this position it takes the lead in establishing variables such as higher margins, loyalty and volume (GERZEMA and LEBAR, 2009).

We highlight the position occupied by the TECNOPUC brand when it comes to stature (8.5%) and vitality (8.4%), which are practically equivalent: we can state that the brands that are in this position feature high profitability, a high power to establish margins and a greater potential to create future value.

Lastly, we analyzed the descriptive data of the statistics obtained through the *RepTrak*™ tool indicators (products/services, innovation, place to work, corporate governance, corporate citizenship, leadership and performance) to measure the attributes that most impact the reputation of brands.

Chart 2 – Statistical analysis of the seven dimensions of the RepTrak™ model that evaluate the reputation of the Southern Brazilian Technology Parks.



Source: The author (2011).

Concerning the evaluation of the reputation of the Southern Brazilian Technology Park brands and considering the general average of the attributes evaluated, in an interval from 0.0 to 5.0, they showed favorability towards the TECNOPUC brand (3.7) in relation to the others – TECONSINOS (3.5) and VALETEC (3.4) – as can be seen in Chart 2. Therefore, the TECNOPUC brand stands out in four rates with results above average, namely: Workplace (4.2), Innovation (3.8), Performance (3.7) and Leadership (3.6). However, the TECNOSINOS brand also appeared as being strong in relation to the Workplace indicator, with a result of 3.8, as well as the VALETEC brand in relation to the Innovation attribute, with a rate of 3.6. When compared with the other three attributes – Products/Services, Governance, Citizenship – we notice that they co not show a relevant variation among the brands studied, with the exception of the Governance indicator (3.1) for the VALETEC brand.

FINAL CONSIDERATIONS

The objective of the study was to analyze the behavior of the BrandAsset® Valuator (BAV) indicators for the brands of Technology Parks operating in the State of Rio Grande do Sul, as well as to measure the attributes of the reputation according to the seven dimensions proposed by RepTrak™, with the target public being entrepreneurs with businesses in technology parks (VALETEC, TECNOSINOS and TECNOPUC), with the results showing that in all aspects studied, the TECNOPUC brand obtained better positioning in relation to the TECNOSINOS and VALETEC brands, there is a certain balance between the brand value perceived by respondents about the parks, with TECNOPUC taking a slight advantage. Hence, we can infer that one reason for this could be attributed to the dynamic and positive work environment that reflects in the perceived image, notably measured by the RepTrak™ indicator, as the best workplace in relation to other parks.

Moreover, with less impact, but also relevant, TECNOPUC stood out because of the following key factors: innovation, performance and leadership. The brands rated as active in the mass market, TECNOSINOS and VALETEC, presented the following predominant characteristics respectively: workplace and innovation.

On completion of this study, we point out that, although the data used were derived from quantitative research carried out using the BrandAsset® Valuator model, we sought to avoid subjective interpretations. To this end, we used the RepTrak™ model to support the analyses and interpretations. This offered subsidies to arguments to the extent that the statistical analysis was repeated as a means of confirming the results obtained.

BIBLIOGRAPHICAL REFERENCES

AAKER, David A. **Marcas: Brand Equity gerenciando o valor da marca.** São Paulo: Elsevier, 1998.

_______________. **Criando e administrando marcas de sucesso.** São Paulo: Futura, 2001.

GERZEMA, John. LEBAR, Edward. **A Bolha das Marcas: a iminente crise de valor das grandes marcas mundiais.** Trad. Ricardo Bastos Vieira. Rio de Janeiro: Elsevier, 2009.

GIL, Antonio Carlos. **Métodos e técnicas de pesquisa social.** São Paulo: Atlas, 1999.

HUTT, Michael D. SPEH, Thomas W. **B2B: Gestão de Marketing em Mercados Internacionais e Organizacionais.** Trad. Luciana de Oliveira Rocha. Porto Alegre: Bookman, 2002.

JUNGMANN, Diana de Mello. BONETTI, Ester Aquemi. **A caminho da inovação: proteção e negócios com bens de propriedade intelectual: guia para o empresário.** Brasília: IEL, 2010.

KELLER, Kevin Lane. MACHADO, Marcos. **Gestão estratégica de marcas.** São Paulo: Pearson Prentice Hall, 2006.

MALHOTRA, Naresh. **Pesquisa de marketing: uma orientação aplicada.** Trad. Nivaldo Montingelli Jr.; Alfredo Alves de Farias. Porto Alegre: Bookman, 2001.

MOREIRA, César Tavares. NETO, Rafael Olivieri. **Marketing business to business: é fazer ou morrer.** São Paulo: Makron Books, 1998.

PLONSKI, Guilherme Ary. **Bases para um movimento pela inovação tecnológica no brasil.** São Paulo: Revista São Paulo em Perspectiva, v. 19, n. 1, p. 25-33, jan./mar. 2005.

ROSA, Márcio. **A reputação – na velocidade do pensamento – imagem e ética na era digital.** São Paulo: Geração Editorial, 2006.

SPOLIDORO, Roberto. AUDY, Jorge. **Parque científico e tecnológico da PUCRS: TECNOPUC**. Porto Alegre: EDIPUCRS, 2008.

ZEN, Aurora Carneiro. HAUSER, Ghissia. **A articulação e o desenvolvimento dos parques tecnológicos: O caso do Programa Porto Alegre Tecnópole.** Bahia: ALTEC, 2005.

BREAKTHROUGHS IN BIOFUELS USING THE TRIPLE HELIX MODEL; MOBILE TECHNOLOGY DEVELOPMENT AND IMPLEMENTATION FOR BIODIESEL PRODUCTION FROM INDONESIAN RESOURCE

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Abstract

The presentation will provide an overview of a research program aimed at the development of a local/community-scale biodiesel industry and waste products thereof in Central/South Kalimantan area to Stimulate the local economy and particularly local agricultural activities, Prevent further degradation of the environment and particularly that of sensitive peatlands, Reduce the chances of forest fires leading to haze problems throughout South East Asia, Stimulate the transition of Indonesian into a biobased economy, Reduce the Indonesian dependency of fossil resources like crude oilResearch and development activities in the Chemical engineering, Logistics and Business development disciplines are performed and include: a. Technology domain: Use of (purified) Pure Plant Oils from local resources (rubber seed oil, palm oil, and possibly in the near future also Jatropha oil), Development of mobile biodiesel technology using acid/base catalysts as well as home-made lipases (e.g. using enzymes extracted from germinating Jatropha Curcas seeds) in highly integrated reactor/separator devices using methanol or locally produced bio-ethanol, Development of technology for the valorization of protein by-products with an emphasis on livestock feed and biofertilizer to improve the soil structure and reduce dependency of expensive fertilizers, b. Logistic domain: development of models for mobile processing units for multiple products (with limited shelf-live and/or optimal harvesting moment) and multiple end products to optimize production capacity, c. Business development domain: a local economic resource development (LERD) program, establishment of a framework and concrete action plan for all stakeholders involved in the introduction of new technology including local government planners, small entrepreneurs and NGO's and creating a conducive environment.
The integrated interdisciplinary project started in 2010 and is carried out by 6 universities (three in Indonesia, three in the Netherlands) and is divided into 7 discrete subprojects, to be carried out by four Indonesian sandwich PhD students and two postdoctoral fellows (one from Indonesia and one Dutch). The presentation will provide an overview of the project, the main findings sofar, with a special emphasis on the Local Economic Resources Development subproject in the business development domain.

Talking about business, business today must be socially and environmentally responsible. Industrial and toxic waste also greenhouse contributed so much in global warming and triggered natural disasters. Implementing green economy can be one of the best solutions to this issue as well as a beneficial innovation in business industry. Recently, green economy has been a hot issue in the media and among business people in relation the responsibility for any effect cause by the activities of their industry which ruined the ecosystem. By looking at the importance of this issue, it is believed that a conceptual study on the implementation of green economy in telecommunication industry such as Bakrie Telecom (BTEL) must be conducted. This study analyzed the implementation using green economy concepts from the perspective of other researchers/academicians and the Government role in supporting this issue. It is found that BTEL has implemented green economy in their company well enough as a responsible innovation for the sustainability of their business, resources, and environment. However, a synergistic cooperation between academicians, government and business sectors, telecommunication industry in particular, are fully suggested. In addition, a serious attention from the Government as the stakeholder and the controller is the most essential element in making the program successful. It is fully suggested that a more comprehensive study with a comparison of many, not just one, telecommunication companies must be conducted to provide better findings.

Keywords: local development, Kalimantan, biofuels, technology development, implementation, stakeholders

IMPLEMENTATION OF GREEN ICT IN INDONESIA: A CASE STUDY OF BAKRIE TELECOM

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Abstract
Talking about business, business today must be socially and environmentally responsible. Industrial and toxic waste also greenhouse contributed so much in global warming and triggered natural disasters. Implementing green economy can be one of the best solutions to this issue as well as a beneficial innovation in business industry. Recently, green economy has been a hot issue in the media and among business people in relation the responsibility for any effect cause by the activities of their industry which ruined the ecosystem. By looking at the importance of this issue, it is believed that a conceptual study on the implementation of green economy in telecommunication industry such as Bakrie Telecom (BTEL) must be conducted. This study analyzed the implementation using green economy concepts from the perspective of other researchers/academicians and the Government role in supporting this issue. It is found that BTEL has implemented green economy in their company well enough as a responsible innovation for the sustainability of their business, resources, and environment. However, a synergistic cooperation between academicians, government and business sectors, telecommunication industry in particular, are fully suggested. In addition, a serious attention from the Government as the stakeholder and the controller is the most essential element in making the program successful. It is fully suggested that a more comprehensive study with a comparison of many, not just one, telecommunication companies must be conducted to provide better findings.

Keywords: Green ICT, Bakrie Telecom, Benefits

1. Introduction

Green economy has become more known in Indonesia since the last couple of years although its implementation by the enterprises is still rare. Indonesian Environmental and Protection Minister, Gusti Muhammad Hatta, said that there were only several provinces in Indonesia which had implemented green economy in their local regulation (bisnis-jabar.com, 2011). One of them is Bali which is implementing green building. Its emergence in the world especially in Europe and United States was way before any other developing Asian countries had thought about it. Approximately 10 percent of German consumers and 12 percent of U.S. consumers are willing to pay 10 percent more for green products that require less energy to operate or are manufactured by companies with a green reputation (Booz&Co., 2008). Nowadays, people are beginning to be more aware of the need of environmentally-friendly-based industry. This issue came up after the issue of global warming arose. Global warming is a phenomenon which most of them is caused by the industrial sectors. High hopes also rest upon ICT to reduce resource and energy consumption in other economic sectors, and thus mitigate global warming (Mattern, Staake, and Weiss, 2010). Industrial and toxic waste also greenhouse contributed so much to worsen the temperature of earth and triggered natural disasters. Mohammad B.S. (2011) mentioned that according to Gartner, the process of making, using, and wasting ICT products such as Base Transceiver Station (BTS), cellular phone, television, radio, broadband, and narrowband have contributed about 2% of the total CO_2 global emission. Booz&Co. (2008) also emphasized that sustainable and environmentally conscious practices are starting to influence both products and services. Therefore, this phenomenon has forced the telecommunication industry to make a change by implementing green ICT, in particular, as consequences of what they had done to earth and the ecosystem. As environmental sustainability has become more important in recent years in parallel with rising energy costs, a growing number of large infrastructure systems and processes have been optimized to consume less power (Mattern, Staake, and Weiss, 2010).
The telecom companies that can effectively build—and, just as important, publicly present—green credentials stand to gain a significant share of this consumer segment (Booz&Co., 2008). Therefore, green ICT is seriously needed and very urgent to be implemented in the telecommunication industry to replace the old classic way to run a business which focused only on profit. This industry was expected to be socially and environmentally responsible as well as promising the sustainability of profits and the environment. This paper provided discussions on the implementation of green ICT in Bakrie Telecom and the Government role in supporting the program.

2. Literature Review

Green ICT

The Indonesian Environmental and Protection Minister, Gusti Muhammad Hatta, believed that the indicator that the company has implemented green economy is by looking at their consideration of implementing green initiatives in their business activities (Bisnis Jabar, 2011). "Green and cool ICT" is defined as ICT which, as a result of usage, produce comparatively low levels of carbon emissions while having the potential to exponentially reduce emissions in other areas by catalyzing technological, institutional and behavioral change, while bringing forth socio-economic benefits (Fernando and Okuda, 2009). Another source believed that Green ICT is a part of global program in achieving sustainability of the world's development and lessen carbon emission (Mohammad B.S., 2011). Koutitas and Demestichas (2010) argued that an important reduction of CO2 emissions can be accomplished by focusing on innovative telecommunication services like online taxation, video conference, online billing that can enable a green economy.

According to the previous study from Booz & Co. (2008), there were many telecommunication company have implemented green initiatives in their business, such as AT&T, British Telecom, China Mobile, Deutsche Telecom, KPN, Orange, Swisscom, TDC, Telecom Italia, Telefonica, Telekom Austria, Telenor, Telia Sonera, Telstra, Telus, Verizon, and Vodafone. All of these companies have been using ISO 14001 for their standard of operations and used renewable energies in their production process. Other green initiatives like recycling program, e-billing system, and paperless office, were still implemented by some of the companies previously mentioned (see Table 1). By 2015, we aim to reduce our CO2 emissions by 60 per cent compared to 1990 and increase our energy efficiency by 20 per cent compared to 2009 (Swisscom, 2011).

	AT&T	British Telecom	China Mobile	Deutsche Telekom	KPN	Orange	Sprint	Swisscom	TDC	Telecom Italia	Telefonica	Telekom Austria	Telenor	TeliaSonera	Telstra	Telus	Verizon	Vodafone
ISO 14001	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Low-emission car fleet	✓	✓	✓	✓		✓			✓	✓	✓	✓			✓	✓	✓	✓
Staff training	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓			✓	✓		✓
Recycling program	✓	✓	✓	✓		✓	✓		✓		✓	✓	✓		✓	✓	✓	✓
Renewable energies	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Teleconference/ teleworking	✓	✓		✓		✓		✓		✓		✓	✓	✓	✓	✓		✓
Paperless office	✓	✓		✓		✓	✓		✓		✓	✓			✓	✓	✓	✓
e-Billing system	✓	✓	✓	✓		✓		✓			✓	✓			✓	✓	✓	✓
Green awards and rankings*		✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓

✓ Areas of activity per operator

* Carbon Disclosure Project's Climate Disclosure Leadership Index, Dow Jones Sustainability Index, Sustainability Yearbook, Environmental Excellence Award

Source: Booz & Company, company websites

Table 1. Overview of Telecom Service Providers' Green Initiatives (Booz & Company, 2008)

A research by ABI Research found that out of 1,000 respondents, 41 percent said they would be significantly more likely to buy services from telecom providers with green credibility, and 45 percent said they'd be more likely to buy devices from telecom companies that are seen as green (Green Electronics Daily, 2009).

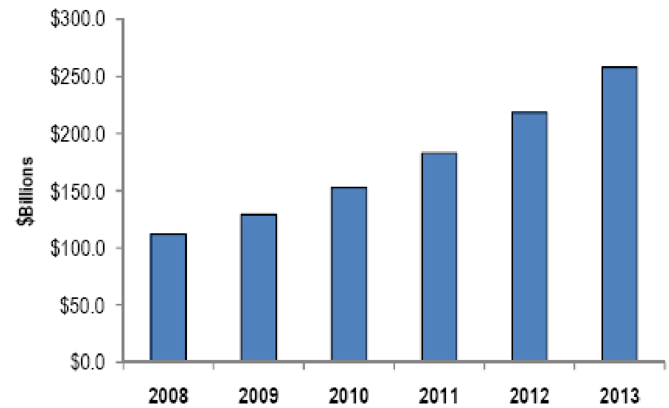


Figure 1. Worldwide Green Communications Technologies Revenues, 2008-2013 ($Billions)
Source: The Insight Research Corporations (2008)

According to a research by The Insight Research Corporation (2008) on the revenues of telecommunication industries worldwide from the period of time of 2008-2013, spending on green communications is expected to increase approximately 34 percent while the number of subscribers of green communication is expected to increase about 36 percent (Figure 1). Our revenue estimates are based upon sale of base technologies solutions making up the five solutions sets below which enterprise or end-user can implement, such as (The Insight Research Corporation, 2008):

- ❖ Transportation power consumption (fossil fuel-based transportation power);
- ❖ Demand side management power consumption (more cost efficient and timely manner);
- ❖ Heating, ventilation, and cooling (Machine-to-Machine improving operational efficiency and productivity);
- ❖ ICT equipment recycling (focuses on materials extraction and recycling); and
- ❖ Environmental audit and compliance systems (for the purpose of regulatory fulfillment reporting).

Swisscom as one of the green telecommunication company reported two initiatives to optimize energy consumption and minimize waste with green ICT, namely reducing energy consumption by using energy-efficient laptops and reducing paper consumption by using e-invoice (Swisscom, 2011). They also said that to reduced travel cost with green ICT, it is suggested to hold virtual meeting, avoid unnecessary journeys, and implement teleworking where work can be done from home. Any, even incremental, reduction in power usage will contribute significantly to improve carbon footprint in telecommunication industry (Amanna, 2009).

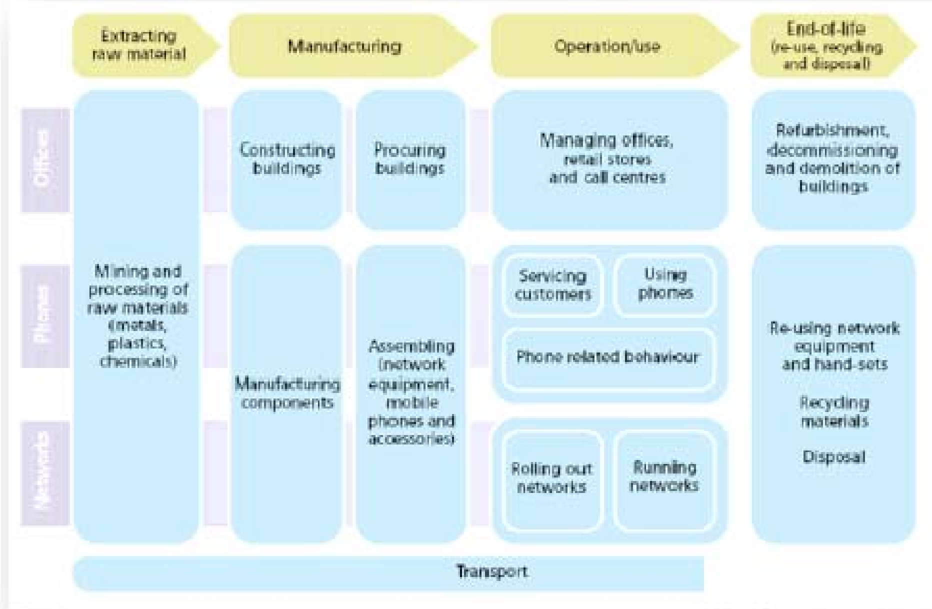
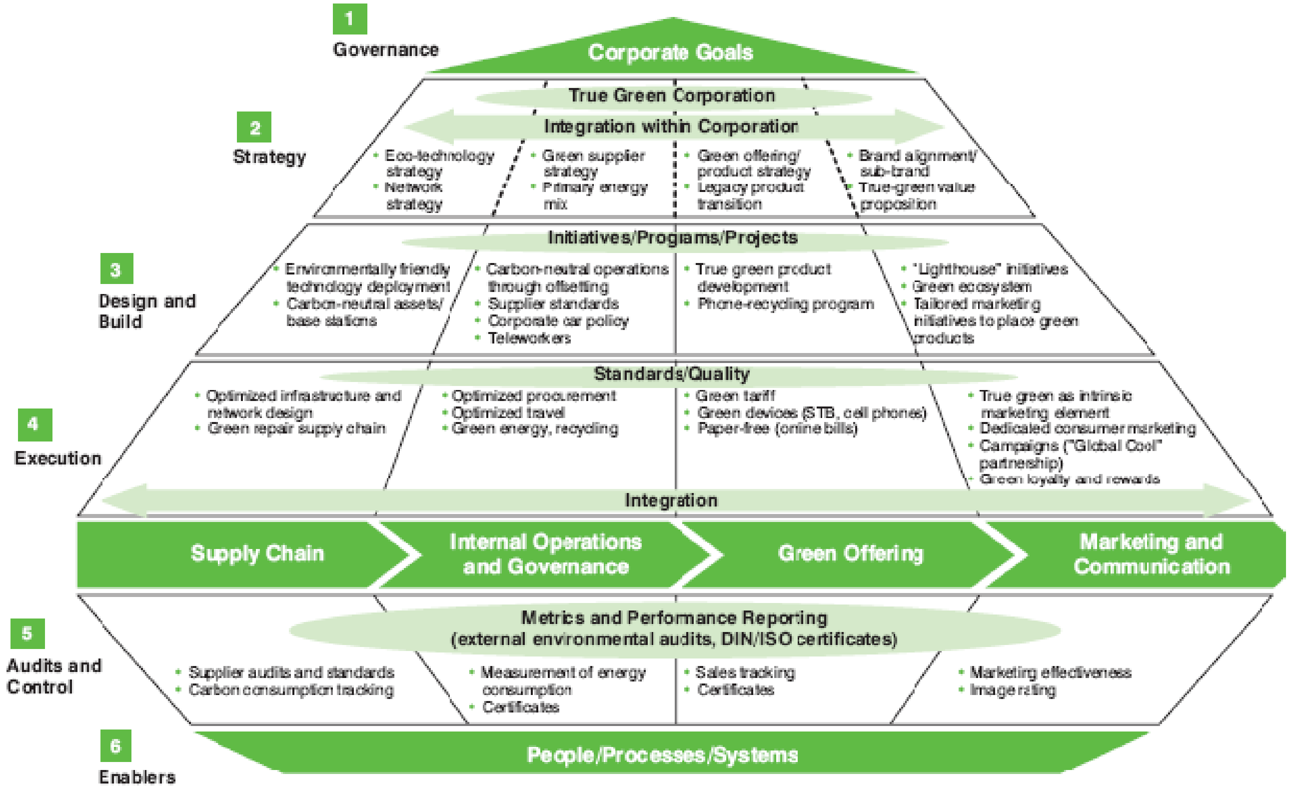


Figure 2. Cellular Lifecycle (Amanna, 2009)

Figure 2 above shows the lifecycle of cellular where the first stage is extracting raw material, manufacturing, operation/use, and last stage is the end-of-cycle. There were also several elements of process contained in each stage which could exist whether in one area or in all three areas (namely networks, phones, and offices). Another reference proposed that “fiber optics, energy efficient data centers and power management of fixed broadband networks proved to be a solution, whereas for mobile operators, access networks and base station technology is the greatest importance” (Koutitas and Demestichas, 2010). Having known the lifecycle of cellular, Booz & Co. (2008) introduced true green corporation framework which is provided in figure 3 below. This framework can be used for telecommunication companies in implementing green ICT. It provides top-down layers from the governance, strategy, design and build, execution, audits and controls, and enablers. Governance is the corporate goals; strategy is the corporate business strategy; design and building includes adjusting the green strategy to current products/services; execution includes the realization of green initiatives; audits and control consist of controlling suppliers and obtaining green ICT certificates; last, the enablers layer includes people, processes, and the systems.



* Carbon Disclosure Project's Climate Disclosure Leadership Index, Dow Jones Sustainability Index, Sustainability Yearbook, Environmental Excellence Award
Source: Booz & Company, company websites

Figure 3. True Green Corporation Framework (Telecom Service Provider Example)
Source: Booz & Company (2008)

Figure 4 provides the details of green initiatives which can be applied in supply chain, internal operations and governance, green offering, and marketing and communications. This figure could also set a benchmark for the operations of telecommunication industry. Much of its initiatives were quite similar to other models provided by the previous researchers.

Figure 4. Green Elements along with the Service Provider Value Chain (Booz & Company, 2008)

Overall benefits of green and cool ICT would be realized with a critical mass of users, economies of scale for producers and service providers, and enabling policy environments (Fernando and Okuda, 2009). These benefits were:

- ❖ Provide information in standard forms on energy consumption and emissions, across sectors while incorporating monitoring information into the design and control of energy use;
- ❖ Improve accountability of energy consumption and carbon emissions;
- ❖ Offer innovations that capture energy efficiency opportunities across buildings/homes, transport, power, manufacturing and other infrastructure and provide alternatives to current ways of operating, learning, living, working and traveling;
- ❖ Offer smart and integrated approaches to energy management of systems and processes, including benefits from both automation and behavioral change and are alternatives to high carbon activities, across all sectors of the economy

Bakrie Telecom Green Initiatives

Bakrie Telecom (BTEL) is one of the leading Indonesian telecommunication companies to implement green economy in running their business. According to official website of Bakrie Telecom (BTEL), they have 12,1 Million subscribers in Indonesia, network coverage in 82 cities in Indonesia, and Rp. 2,545 Billion operating revenue. Recently, BTEL have won many prizes such as "Top Brand Award 2010" for pre-paid and post-paid CDMA from Frontier Consulting Group and Marketing Magazine, "Sales Force Championship 2010" for the Best Manager, Supervisor and Salesman categories from Force One and Marketing Magazine, "3G CDMA Industry Achievement Awards 2010" for the Innovation in Wireless Social and Economic Solutions Development category from the CDMA Development Group, Six awards for "The Best Contact Center Indonesia 2010" from the Indonesia Contact Center Association, and many more (BTEL Annual Report, 2010). Referring to all the prizes and awards they have been awarded, BTEL thought that they need to reform their business by implementing green economy in order to be responsible to the society and the environment.

BTEL started using green economy since 2010 and since then, they have achieved many benefits which one of them is lower production costs. BTEL green economy program was well known as Hijau Untuk Negeri (hereinafter will be called **Green for the Nation**). The following is BTEL green economy initiatives:

No.	Types of Initiatives	Implementation	Objectives	Results
1.	**Network Energy Efficiency**	More than 2,000 base stations are fitted with free cooling technology which depends on outside air to cool equipment; eliminating the need for air conditioning	To reduce the Company's greenhouse gases footprint	It reduce power consumption by more than 30% per year
		Delayed start generator which is used in areas which are less dependent on electric power	To maximizes the period without electricity and when the base station is short of battery power	BTEL can save an average of 40 liters of diesel fuel per site per power application, and significantly reduce generator operating costs and maintenance
		Minimum network operating carbon footprint	For more efficient services to customers	The Company has reduced its carbon footprint by sharing co-located towers with other operators
2.	**Collecting Discarded Handsets for Refurbishment or Recycling**	Refurbishing or recycling discarded handsets	To reduce electronic waste	
3.	**Green Power**	Build base stations that generate electrical power from solar energy	To exploit renewable resources while saving energy	
4.	**Supplying Green**	Sustainable supply chain system	*a.* Obtaining resources from suppliers and vendors that are environmentally-friendly *b.* Creating products labeled as 'environmentally-friendly' in accordance with their environmental performance criteria, including energy efficiency and recycling efforts *c.* Determining the environmental criteria for all products and services provided by Bakrie Telecom *d.* Working closely with partners in providing a sustainable contribution	

			to the development of environmentally-friendly performance	
5.	**Green Warehouse**	Treating IT and network equipment that are obsolete with care	To minimize impact of the metal or chemical content	BTEL minimizes waste and trash from its operations, and ensures that all electronic waste be recycled or handled properly
		Ensuring that these resources are transformed into new products and useful material, or disposed of appropriately	To prevent them in becoming hazardous electronic waste	The Company is able to recover resources from innovations deemed not useable and then reuse the material creatively; this action not only saves resources, but also saves money
6.	**Green Office**	Reducing paper usage, encouraging employees to recycle paper for drafting documents, recycling paper and printer cartridges as well as focusing on saving electricity at work	To make the office more environmentally-friendly	
7.	**Employee Involvement**	Disseminating this understanding and encourages employee participation by conducting outreach programs toward all sections of the Company	To increase employees' understanding of the importance of preserving the environment, beginning with their personal lives, their behavior in the office and their roles as part of Indonesian and global societies	

The green initiatives above were already done while some others were still on the run. Referring to what they stated in the article entitled "Green Economy is the World's Responsibility" on the official website (www.bakrietelecom.com), green economy is a future investment. Chief Director of Bakrie Telecom, Anindya Bakrie also said that it is expected that BTEL will earn not less than Rp. 20 Billion of total savings by implementing this **Green for the Nation** program in 2011 and that the initiative was expected to create a positive wave that produces sustainable evolution for the Company and Indonesia. BTEL was also the first telecommunication operator in ASEAN to join GeSI (Global e-Sustainability Initiative). Moreover, BTEL and other 5 leading company in Indonesia agreed to be the pioneer and creator of Indonesia Business Council for Sustainable Development (IBCSD). Based on BTEL Annual Report in 2010, below is BTEL future plan in Green ICT:

1. Reducing costs through the implementation of **Green for the Nation** program goals by continue to identify and seek cost and energy saving measures as well as implementing efficiency measures, in line with the development of BTEL as an organization
2. Positioning BTEL and BCON as "Green Choices" that are environment-friendly and convincing customers that using BTEL products is good for the planet, through a coordinated branding campaign which will resulted in the increasing yield of benefits of cost-effectiveness and also have a positive impact on AHA service users
3. Strengthening ties with the Ministry and other related institutions, the mass media and the Chamber of Commerce, through the understanding that BTEL is a forward-thinking company and has integrated the concept of the environment in its strategy and has benefited from this action
4. Attract potential new investors who are concerned about issues of corporate social responsibility and investors who are socially responsible

5. Becoming part of the Global e-Sustainability Initiative (GeSI)
6. External Audit and certification of BTEL's progress in objectively achieving environmental sustainability

Objectives and Methodology

The objectives of this study were to provide conceptual understanding on green ICT and the example of implementation by Indonesian telecommunication industry (Bakrie Telecom). This case study used a literature review method where literatures regarding the issues discussed were gathered from online newspaper, research papers, and articles. These references were used to provide guidelines on how green ICT works and the benefit of implementing the innovation. Literature review method was also useful for conceptual research which is needed for a more comprehensive future research in the area of study. This paper evaluates Bakrie Telecom (BTEL) green program (**Green for the Nation)** using green telecommunication models proposed by previous researchers.

Analysis of BTEL Green Program

In Indonesia, there are two basic national philosophies which can be used as a foundation of the implementation of green economy. The first is Pancasila, where it is clearly stated in the second philosophy "Kemanusiaan yang adil dan beradab" and the fifth philosophy "Kesejahteraan sosial bagi seluruh rakyat Indonesia". In other words, the above philosophies tries to make Indonesians aware that human being must be able to act wise and responsible of what they have done. Moreover, the fifth philosophy said that prosperity is meant to be for every Indonesians. The second philosophy is taken from UUD 1945 Chapter XIV on National Economy and Social Prosperity article 33 which originally says, "Perekonomian kita disusun sebagai usaha bersama atas asas kekeluargaan dipergunakan untuk sebesar-besarnya kemakmuran rakyat diselenggarakan atas dasar prinsip berkelanjutan dan berwawasan lingkungan". It can be said that Indonesian economic is designed to be on the basis of family, utilized as much as it can for the people of Indonesia within the corridor of environment sustainability and knowledge. Therefore, to conclude, the economic in Indonesia has to be based on the environment sustainability in order to be able to keep the sustainability of human resources, natural resources, and renewable resources.

Looking at the case of Bakrie Telecom above, BTEL has walked on the right track for profits, environment, and social sustainability. BTEL consider applying green ICT in almost every elements of their business process. In terms of network energy efficiency initiative, they were trying to make their production efficient by implementing base stations with free cooling technology, delayed start generator, and minimizing network carbon footprint. Jalal (2011) mentioned in his article that compared to the existing efficiency today, to make the world sustainable, it needs about ten times efficiency or it is well known as "Factor 10". Insight research corporations (2008) also agreed that power consumption shall be cost efficient and timely manner. Besides, M2M (Machine-to-Machine) technique to optimize operations were also important. Therefore, it is better to start the efficient production process now rather than delaying it to the next year because the ratio of efficiency requirement tomorrow might be worse than today.

In terms of refurbishment and recycling discarded products such as handsets, BTEL has maximized the capacity of these headsets and reduce the use of new resources to produce the new headsets. It is believed that some parts of the old headsets can still be used to make the new one. This was in line with Amanna (2009) which suggested that reuse of networks equipments and handsets could be done for phone and network in the end-of-use cycle.

Seputar Indonesia (2011) online newspaper cited that the indicator of green economy in a company is whether the company has always considered the environmental problem or not. In Bali Province for example, almost every hotel in Bali used green building where they had the obligation to use minimum 10% of solar energy. Without the use of solar energy, there will be no license can be given for building a hotel. The International Labor Organization estimates that renewable energy could generate up to 20 million new jobs, if it were to represent 30 percent of the worldwide energy output (Antara News, 2011). Consequently, in terms of green power initiatives, BTEL has surely effectively exploited the renewable energy provided on the ecosystem. Furthermore, according to The Insight Research Corporations (2008), most of the studied telecommunication industries in the world have already used renewable energy.

In terms of supplying green, beside for the reason of effectiveness and efficiency, BTEL has contributed to spread the word of green business in which they will become more aware of the environmental problems and will push themselves to be greener in order to fulfill BTEL standards. Auditing and controlling supplier is also necessary as well as using green repair supply chain (Booz & Company, 2008). This knowledge chain will bring bigger benefits in the future because the relationship of the supplier will also be affected by the awareness.

As for the green warehouse and green office initiatives, it is believed that the initiative will maximize the use of paper and other utilities which came from natural resources and therefore will resulted in less wastes. Amanna (2009) proposed that in the end-of-use cycle, refurbishment, decommissioning, and demolition of building is the best application for green building. By applying this idea, BTEL supposed to saves much of its purchasing costs. Another alternative is to have green shop concept (Booz & Company, 2008). Moreover, among 18 telecommunication companies throughout the world studied by them, only 12 have initiated paperless office. So BTEL can be a leading innovator in Indonesia for having green office in the operation of their business.

In terms of employee involvement, BTEL has showed their totality in implementing green economy in their company because they were also concerned for their employees' environmental knowledge. In their personal lives, their behavior in the office, and their role as a part of Indonesian and global societies. It became an important step as Budimanta (2011) said that green economy has to be supported by all elements of society and employee is one of them due to their status in the company. Moreover, he said, to move to a green economy industry, knowledgeable human resources with the capability to adapt and compete with the international market are needed. The arguments were in line with most of the telecom companies such as AT&T, British Telecom, and Vodafone which have provided staff trainings regarding these green issues (Booz & Company, 2008).

Realizing green economy is of course not an easy way considering there are many types of persons with different kinds of cultural background, especially here, in Indonesia. Budimanta (2011) in his article entitled "Green Economy: What Should We Do?" mentioned that the most important constraints in green economy is the model which can be used as the technical guidelines and a detail calculation to be put in the calculation of Indonesian APBN (National Income and Expenditure) as a supportive fund for any company who would like to apply green economy.

Reflecting on the constraint that might arise, Jalal (2011) proposed the "recipe" towards green economy. The first is to stop the "blaming game" where people running the business now tend to have a negative blame on the previous employees or leader. In order to be able to accept and adapt with the significant improvement which will be experienced, it is suggested to switch the bad habit into "cooperation" to find the best solution for the future. Second, company must also be responsible of their own waste and any effect from the production which affected the environment. It can be done by minimizing pollutions, efficiency of energy and material used, and maximizing the positive impact to the environment. Third, civil society is also encouraged to contribute by supervising the company's performance in green economy as well as confirming their claims. Fourth, the government is expected to control the regulation of the company. Most of all, the cooperation between the three sector or main elements of green economy must be sustainable and willingness to learn and work together must also be maintained.

Generally, BTEL green economy implementation is good enough. Although, it is believed that they still need to work harder and be a visionary to be the best pioneer in green economy in Indonesia. In addition, what Jalal had mentioned in his "recipe" is also true. Another point to include is that a good synergy between the academicians, government and business sector (well known as triple helix model) is vital. Academicians and researchers can give contribution by always up to date to environmental issues in the world and always provide high quality researches. On the government side, they can contribute by controlling the run of these business industries especially in terms of environment sustainability and providing supportive incentives for any company who are pro to environment. Last, business sectors are expected to give their best contribution for using human resources, natural resources and renewable resources efficiently and effectively. In addition, Amanna (2009) also agreed that "the cellular industry can realize cost savings and lower their impact to the environment, government agencies realize fulfillment of administrative goals for energy savings as well as development of standards and metrics, while researchers can push the boundaries of current technologies and theories in material science, distributed computing and system engineering."

Conclusion and Further Research

To conclude, green economy (in this case green ICT) is one of the best ways to be sustainable. Sustainability in terms of profits, environment and social can be achieved. By applying this model, of course, Indonesia will have a chance to show their quality to the world. As for Indonesia, a study analyzing the impacts of switching to a low-carbon economy has shown that investing more in energy efficiency, reducing the use of coal-based fuels and stopping deforestation, could improve per capita incomes and help ease the level of unemployment (Antara News, 2011).

Reviewing from the previous studies on green ICT, it seemed that Bakrie Telecom has implemented their green program very well. It covered almost all aspects of their business and they appeared to be serious by synergizing this with their employees, giving them the opportunities to be a part of green economy in the company. However, their contribution in using teleworking or teleconference, to reduce transportation costs and avoid unnecessary traveling, still needs improvements. They also need to consider e-billing and green campaigns (Booz & Company, 2008) to support their program as well as increasing people's awareness in using eco-friendly telecommunication products/services.

For further research, it is suggested that a more comprehensive study covering details of green ICT implementation and more book resources which are currently published will help to analyze the case more objectively. Moreover, providing many evidence of green economy implementation by small enterprises will also be very interesting.

References

Amanna, Ashwin (2009). Green Communications: Annotated Literature Review and Research Vision. Virginia Tech

Antara News (2011). Indonesia's Green Economy Strategy: RI Starts Looking At Green Economy Strategy. Retrieved on December 10, 2011. Available on http://www.antaranews.com/en/news/12...onomy-strategy

Bakrie Telecom (2011). Ekonomi Hijau Jadi Keharusan Dunia. Retrieved on December 15, 2011. Available on www.bakrietelecom.com/pressroom

Bakrie Telecom (2011). Hijau Untuk Negeri. Bakrie Telecom 2010 Annual Report. Retrieved on December 14, 2011. Available on www.bakrietelecom.com/files/document/BTEL_AR2010_Eng.pdf

Bisnis Jabar (2011). Baru 6 Perusahaan di Indonesia Terapkan Green Economy. Retrieved on December 10, 2011. Available on http://bisnis-jabar.com/index.php/2011/09/baru-6-perusahaan-di-indonesia-terapkan-green-economy/

Booz & Co. (2008). Going Green Addressing Untapped Consumer Potential in the Telecom Industry.

Budimanta, Dr. Arif (2011). Ekonomi Hijau: Apa yang Perlu Kita Lakukan?. Seminar Ekonomi Hijau. BAPPENAS: Jakarta

Fernando, Preminda and Okuda, Atsuko (2009). Green ICT: A "Cool" Factor in the Wake of Multiple Meltdowns. ESCAP Technical Paper

Green Electronics Daily (2009). Nearly Half of Mobile Customers Want Green Telecom, Report Says. Environmental Business, Policy and Technology News, Vol. 2, No. 102

Gunawan and Tjokrodjojo (2010). Indonesia towards Green IT. Eco-Innovation ICT Conference: Jakarta, Indonesia

Jalal (2011). Menuju Ekonomi Hijau: Catatan atas Kontribusi Perusahaan dan Pemangku Kepentingan. Lingkar Studi CSR. Retrieved on December 15, 2011. Available on www.csrindonesia.com/data/articles/20111109221308-a.pdf

Koutitas and Demestichas (2010). A Review of Energy Efficiency in Telecommunication Networks. Telfor Journal, Vol. 2, No. 1

Mattern, Staake, and Weiss (2010). ICT for Green – How Computers Can Help Us to Conserve Energy. Available on www.google.com

Seputar Indonesia (2011). Mencari Model Bisnis Hijau. Retrieved on December 15, 2011. Available on http://www.seputar-indonesia.com/edisicetak/content/view/448815/

Swisscom (2011). Good for your Image, Good for your Budget. Online Brochure. Retrieved on April 18, 2012. Available on www.swisscom.ch/green-ict

The Insight Research Corporation (2008). Communicating Green: Telecommunications Value in Promoting Environmental Improvement 2008-2013. U.S.A.

POTENTIAL MARKET FOR ECO LABEL PAPRIKA IN INDONESIA

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Abstract
Recently since declaration of Kyoto protocol in 1997, Indonesia committed to participate in reducing CO2 emission. Agriculture sector in Indonesia based on UNFCC data based in 1994 contributed 75,101.12 Gg CO2 equivalent. Therefore, it is important to reduce CO2 emission from agriculture sector. In Indonesia, paprika as one of agriculture product is produce by farmers who associated in Small and Medium Enterprises (SMEs). Paprika has potential market both in national and international, thus paprika's SMEs should have good strategies in order to improve their competitiveness. By developing Eco Label for paprika, it can be one of good strategy since recently consumers begin to have awareness of food safety and environmental issues. In addition, Eco Label also adding paprika value because Eco Label itself claimed that the product is environmentally friendly. Carbon footprint is one part of Eco Label. The methodology to calculate product's carbon footprint is a subset of Life Cycle Assessment (LCA) with a focus on greenhouse gas (GHG) emissions and all inputs of energy (fossil and otherwise), plus all other sources of emissions. The objective of this paper is to discover potential market of Eco Label paprika in Indonesia. LCA methodology was used to calculate CO2 emission from paprika distribution system in Pasir Langu village in order to do carbon footprint so that SMEs' paprika production can be labeled as Eco Label. By using questionnaire and conjoint analysis, this study obtained that there is WTP for Eco Label paprika in Indonesia. So we can conclude that there is potential market for Eco Label paprika in Indonesia and paprika's SME can start to develop eco label in order to improve their competitiveness. In the future, optimization model of distribution system of paprika is necessary to be done in order to mitigate CO2 emission and questionnaire is necessary to be distributed to both exporter and importer to discover potential market of Eco Label paprika in international market. A policy implication regarding environmentally friendly business is necessary to establish.

Keywords: Eco Label, LCA, Conjoint, Paprika

1. Introduction

Indonesian agriculture supports the livelihood of millions of Indonesians. Three out of five Indonesians still live in rural areas and farming is their main occupation. While Indonesian agriculture has performed well historically and contributed to significant growth with increased employment and reduction of poverty, productivity gains of most crops have now slowed down significantly and the majority of farmers operate in less than one-half hectare today [17]. Agricultural sector remains playing an important role in the economy of the country, indicated by its role in GDP. Table 1 shows contribution of agricultural sector to Indonesia's GDP [11].

Table 1. Share of Gross Domestic Product Based on 1993 Constant Price, 1970-2004 (%)

Sector \ Year	1971	1981	1991	1996	1997	2000	2002	2004
1. Agriculture	38.47	21.58	19.26	15.59	15	16.64	15.94	15.42
Food crops	18.54	12.06	10.59	8.22	7.73	8.68	8.07	7.77
Estate crops	4.26	2.56	2.86	2.52	2.52	2.69	2.65	2.56
Livestock	3.23	1.85	1.91	1.74	1.74	1.77	1.77	1.72
Forestry	10	3.63	2.22	1.56	1.48	1.61	1.56	1.42
Fisheries	2.44	1.48	1.69	1.54	1.53	1.89	1.89	1.91
2. Industry	6.96	10.7	19.85	23.55	24.1	23.59	23.63	23.89
3. Mining	14.42	12	10.5	9.18	8.93	9.77	9.32	7.92
4. Construction	8.03	16.45	8.06	9.48	9.51	8.64	8.93	9.19
5. Utilities	0.47	0.71	0.95	1.18	1.27	1.65	1.76	1.75
6. Trade, Hotel & Restaurant	13.98	19.34	16.64	16.95	17.11	15.95	16.24	16.33
7. Transport	3.39	4.39	5.84	5.97	6.09	7.3	7.89	9.05
8. Finance	2.33	2.86	4.06	4.86	4.82	6.9	7.02	7.28
9. Services	11.94	11.97	14.84	13.22	13.17	9.56	9.28	9.17
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: Swastika et al. (2005) and CBS (2005) in Maulana (2007)

Vegetable is one of agriculture products which are grown throughout Indonesia, especially on high altitude areas. Recently, Indonesia's population is growing rapidly and it's led to increasing horticultural products consumption, especially vegetables as a source of food [11]. According to Ditjen BP2HP (2004), Indonesia imported 241,000 metric tons (mt) of fruit and 324,000 mt of vegetables in 2001. On the other hand, 21,000 mt of fruit and 113,000 mt of vegetables were exported in the same period. Comparing the import from the export depicts a huge market demand for fruits and vegetables in Indonesia [5].

Paprika is one kind of vegetable which has high value, should grown in the highland area at 750 to 1500 m above the sea, however, the temperature between 16 to 25 deg.C are required for cultivation. Suitable environment is very important for cultivation process because paprika is highly responsive to temperature, sunlight, soil pH, humidity, and water [14]. In Indonesia, the largest central paprika producer is in Pasir Langu village, Lembang, West Java Province. This village has able to produce 20 tons paprika per week, but it's still far below from market demand. International market demand toward paprika from Indonesia is very high. In South East Asia, Singapore is one of potential buyer has a demand 110 tons per week and national production can only meet the demand 40-60 tons. Proportions of paprika market divided into 80% for international and 20% for national market [4].

In addition, international competition will intensify everywhere, even in domestic markets. Competition on costs will remain important, but much more important will be the ability to create differences in markets. The pressure of international competition will lead to remarkable scaling up of companies. Differentiation implies a need for a continuous stream of new products and production processes. It requires a culture that stimulates innovation. Especially, it requires a dedicated marketing strategy, market knowledge including consumer preferences as well as the continuous changes in these preferences [11].

Sector Year

In Pasir Langu village, paprika was distributed by Cooperative Suka Maju and Dewa Family as wholesalers. Both wholesalers are categorized as SMEs. To improve their competitiveness in facing global competition, it is necessary to develop product's differences. By developing Eco Label with carbon footprint can make paprika which produced by SMEs in Pasir Langu village have value added in both international and national market.

The objective of this study is to discover WTP of consumer in Indonesia due to Eco Label paprika. LCA methodology was used to calculate CO2 emission from paprika distribution system in Pasir Langu village in order to do carbon footprint so that SMEs' paprika production can be labeled as Eco Label. A questionnaire and conjoint analysis were used to discover whether there is potential market due to Eco
Label paprika in Indonesia.

2. State-of-the-art

LCA is a tool for evaluating the environmental burdens associated with a product, process, or activity over its entire life cycle [2]. LCA is one of the most widespread methods for assessing the environmental impact of products and services and has been applied in many sectors including food and agriculture [8].

LCA is then based on rigorous mass and energy balances calculated by modeling and/or measuring the material and energy flows of the various systems. These balances are used to evaluate the resource consumption and waste generation inventories of the product or process. LCA adopts a 'cradle-to-grave' approach for quality and cost management in the agriculture and food sectors. This approach involves analyzing all inputs and (non) product outputs that are extracted from environment or disposed to the environment in agriculture, food production, and consumption, and supporting processes (including e.g. transport, energy, fertilizers, pesticides, farm equipment, etc.) [3].

Product environmental labels or eco labels are intended to be a market-based means to internalize externalized costs and to increase public participation in, and raise awareness of, environmental problems. Two of the most general goals provided for product environmental labels are: (1) providing consumers with information (information policy instrument), and (2) reducing the environmental impact of products and consumption (environmental policy instrument) [10]. Carbon footprint is one part of ecolabels. Carbon is used as a general means to communicate the impact on climate change in terms of carbon dioxide equivalents. The methodology to calculate this is a subset of LCA with a focus on greenhouse gas (GHG) emissions such as CO2 and all inputs of energy (fossil and otherwise), plus all other sources of emissions [2].

Willingness to Pay (WTP) is defined as the maximum amount of money that an individual is willing to pay sacrifice to obtain a good or service. It's mean that if the customer has WTP for sustainability, and if a food product carries the added feature of sustainability, the customer is willing to pay some amount of money for this feature. This definition thus leads one to think that WTP is necessarily connected with a price premium [10]. By using conjoint analysis, consumer's preferences and willingness to pay due to eco label product can be investigated. The state-of-the-art of this study is combine LCA methodology and conjoint analysis to discover potential market of Eco Label paprika in Indonesia based on sub-theme of Triple Helix Collaboration for Small and Medium Enterprises (SME): Strategies to boost the business environment for SME.

3. Methodology

Literature concerning LCA methodology, conjoint analysis, and WTP was reviewed. Documents were collected from various sources in such as universities, government institutions, national journals, and international journals. Interviews in Pasir Langu village were conducted with the key informants from wholesalers and farmers in order to figure about life cycle stage and gather data for LCA methodology in paprika distribution system. Questionnaires were distributed through private email in Jakarta.

3.1 LCA Methodology

LCA methodology framework comprises four stages: goal and scope definition; life cycle inventory assessment; life cycle impact assessment; and life cycle interpretation (Figure 1). The goal and scope definition establishes the functional unit, system boundaries, and quality criteria for inventory data. The life cycle inventory analysis deals with the collection and synthesis of information on physical material and energy in- and outputs in the various stages of the product life cycle. In the life cycle impact assessment these environmental input and outputs are assigned to environmental impacts categories, and characterization models used to calculate the contribution of each of these indicators. Finally, the life cycle interpretation deals with the interpretation of the results from both the life cycle inventory analysis and life cycle impact assessment. It includes the identification of significant issues and the evaluation of results [16].

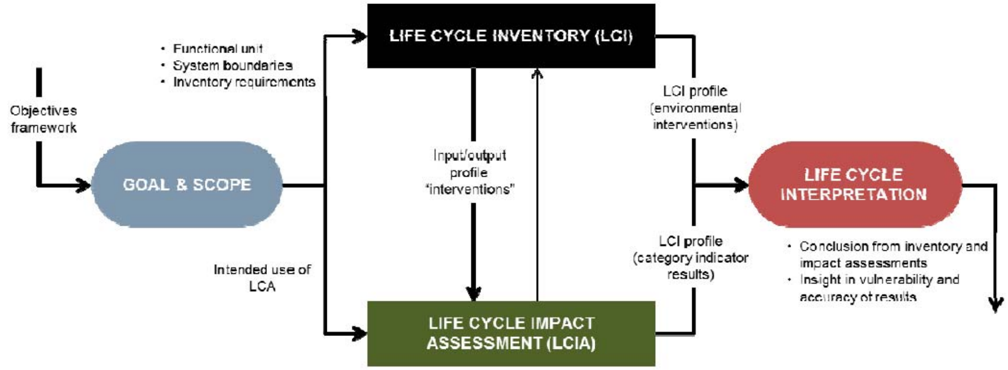

Figure 1. Structure of Life Cycle Assessment

LCA methodology was used to calculate COLCA methodology was used to calculate CO2tion system in Pasir Langu. Distribution process in this study consists of four main processes greenhouse to wholesaler, packaging, and transportation from wholesaler to retailer. A system boundary in this study is shown in Figure 2.

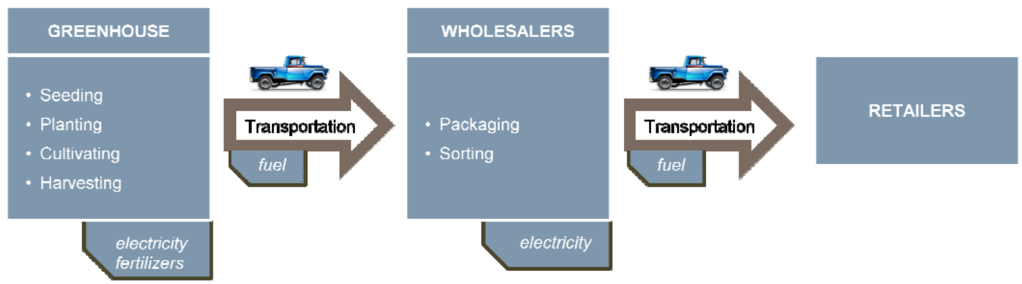

Figure 2. System Boundary

3.2 Conjoint Analysis

Conjoint analysis is a multivariate technique developed specifically to understand how respondents develop preferences for any type of object (product, services, or ideas). It is based on the simple premise that consumers evaluate the value of an object (real or hypothetical) by of value provided by each attribute. Moreover, consumers can best provide their estimates of preference by judging objects formed by combinations of attributes relative importance consumers attach to salient attributes and the utilities they attach to the levels of attributes [13].

Data processing for questionnaire was done by using SPSS 17 software for conjoint analysis and descriptive statistics to describe respondent's successfully collected from 123 respondents. Population of this research is all women who living in Jakarta and has been to the markets (traditional or modern market) that sell paprika. Jakarta was selected as target area of respondents because Jakarta can represent Indonesia market for paprika.

Sampling techniques that was being used in this research is purposive sampling. A purposive sample refers to selection of units based on personal judgment rather than randomization. This judgmental sampling is in some way "representative" of the population of interest without sampling at random. In this study, factors and factor levels (Table 2) were determined to obtain stimuli as combination that will be used in questionnaire.

Table 2. Factors and Factor Levels Used

Factors	Factor Levels
Type of Paprika Cultivation	Environmentally friendly Conventional
Price (per piece in Rupiah)	7700 8050 8400 8750
Emission (CO_2)	High Medium Low

Using SPSS 17 as a tool to produce stimuli, 16 stimuli or combination (Table 3) from 3 factors and 9 factor levels are obtained. Based on these 16 combinations, respondents have to rank the combinations from 1 to 16. Number 1 is the most preferable combination and 16 is the least preferable combination.

Table 3. Stimuli or Combination from Factors and Factor Levels Used

CARD	TYPE	PRICE	EMISSION
1	Conventional	8750	Medium
2	Environmentally friendly	8050	Medium
3	Conventional	8750	High
4	Environmentally friendly	7700	Low
5	Conventional	8400	Low
6	Environmentally friendly	8750	High
7	Environmentally friendly	7700	High
8	Conventional	8050	High
9	Environmentally friendly	8750	Low
10	Conventional	8400	High
11	Environmentally friendly	8050	High
12	Environmentally friendly	8400	High
13	Conventional	7700	Medium
14	Conventional	8050	Low
15	Conventional	7700	High
16	Conventional	8400	Medium

4. Findings and Interpretation

4.1 LCA of Paprika Distribution System in Pasir Langu

LCA methodology in this study was used to calculate CO2 emission from four main processes at paprika distribution system in Pasir Langu (Figure 3). Equation (1) was used to calculate CO2 emission.

$$ECO_{2\,j} = \sum A_i \times FE_i \tag{1}$$

Where, *j* is cultivation, transportation1, packaging, and transportation2 and *i* is electricity, fertilizers, and gasoline. In this study, there are three scenarios of calculating CO2 emission based on differences of distance both in transportation from greenhouse to wholesaler and transportation from wholesaler to alculating the farthest distance. Second scenario is calculating nearest distance both in transportation from greenhouse to wholesaler and transportation from wholesaler to retailer. Third scenario is calculating average distance.

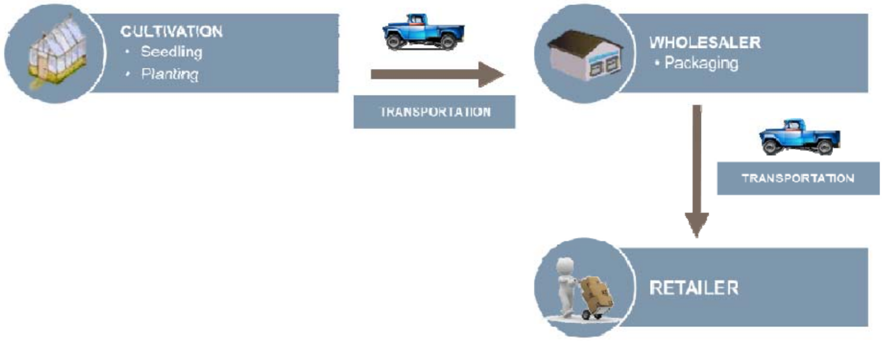

Figure 3. Paprika Distribution System in Pasir Langu

BRAZIL'S OPPORTUNITY TO INNOVATE IN THE FIELD OF SPORTS

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Abstract
The aim of this paper is to describe a study into Brazilian academic spin offs that are developing innovative products and services for the sports market, based on the triple helix model. The results show the characteristics of the products and services of the spin offs in the sporting field that were studied, their innovation sources and the financial resources they have received, as well as the university and government role in stimulating these innovations.

Keywords: innovation, sports innovation, spin-offs, university-industry-government relations, triple helix.

1. Introduction

The prospect of hosting the football World Cup in 2014 and the summer Olympic and Paralympic Games in 2016, as well as the experience of hosting the Pan American Games in 2007, has stimulated discussion in Brazil about the holding of such 'mega-events' and their legacy for the cities and regions that host them[2].This debate has extended into the academic sphere, with scientific gatherings taking place and publications on the topic being released (DaCosta et al, 2008). At the same time, agencies and government bodies that support scientific research have included among their tendering invitations themes devoted specifically to innovation in the sporting field, on the understanding that the country could use this opportunity to become a producer of sports solutions and not just a buyer.[3].

There is a favorable environment in Brazil for the stimulating of technological innovation in business, including non-repayable financial resources, subject to approval and the regulations of the Innovation Law (2004 and 2005) and the launching of federal government economic programs, such as the Plan for a Greater Brazil (2011 – 2015), which seeks to provide continuity and also expand upon the industrial policy measures that had been introduced previously: PITCE – Industrial, Technological and Foreign Trade Policy (2003-2007) and PDP – Policy for the Development of Production (2008-2010).

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[2]Além destes eventos ocorreram também os Jogos Mundiais Militares em 2011 e a Copa das Confederações de Futebol acontecerá em 2013.
[3]Ver Editais: FAPERJ N.° 06/2010. Programa "Apoio ao desenvolvimento de inovações no esporte no estado do Rio de Janeiro – 2010", available on http://www.faperj.br/interna.phtml?obj_id=6166, accessed on March, 21, 2012 and FINEP, available onhttp://www.finep.gov.br/imprensa/revista/edicao8/inovacao_em_pauta_8_esportes_0202.pdf.AccessedonMarch, 21 2012

At the same time, there are a considerable number of incubators in Brazil. According to the most recent survey, in 2011, there are 384 incubators of various kinds (technological, traditional, mixed or cultural), hosting 2,640 companies under incubation and 1,124 associated companies. These companies, under incubation and associated, generate 16,394 jobs. And to this number one can add another 29,905 jobs in the companies that have already been incubated. The revenue generated amounts to R$ 533 million for the companies under incubation and R$ 4.1 billion for those that have already been incubated. According to the same survey, with regard to innovation, it has been found that 15% of the companies innovate on a global level, 55% relate to the country's domestic market and 28% at the local level (Anprotec, 2012).

It has also been observed that, according to the most recent data available, for 2004, a significant proportion of the incubators (72%) are formally linked to universities (Anprotec, 2004), which facilitates the development of spin offs as instruments for the transferring of the know-how and technology generated at those institutions (Etzkowitz et al, 2005).

Academic publications on the legacy of sporting mega-events and addressing their impact have helped to make this a controversial topic. Such studies have covered the social, economic, environmental and cultural dimensions, among others. Behind the scene of hosting some very successful games, there were a large number of initiatives and ventures with various outcomes. Previous experience of countries that have hosted international sporting competition mega-events has shown that the legacy for the host city also covers impacts generated by new entrepreneurial performance in the region, which can affect various economic sectors (Spilling, 1996).

The present global context of professional competitive sports involves considerable Science, Technology & Innovation (S, T & I) development, yielding improved performance from the athletes, which in turn provides sporting success that generates new business opportunities. Hence, the development by companies of closer relations with the universities and government can lead to the creation of new technology and products for the sporting field, spurred by the research potential of the academic institutions and government support. Such The firms that come about (academic spin offs) generate knowledge of the sporting field, through the interaction between university-industry-government, and are linked to a very broad range of knowledge (health sciences, life sciences, applied social sciences, engineering, humanities, linguistics, arts and literature and arts, earth sciences, mathematics, agricultural sciences and others). These knowledge-based firms are linked to the research and development of innovative ideas and are usually, located in incubators, thus becoming business spin-offs.

Business spin-offs should seek, through university-industry-government interaction, to attain the production of knowledge required for business success. For this to happen, universities must be alert to opportunities for innovation in sport and encourage professors and students to create academic organizational structures for developing teaching research and economic development focused on innovation in sport (Etzkowitz, 2008).

Meanwhile, the process by which the results of research, or a technical idea with potential value developed in a university, are converted into one or more commercially successful products, through the generation of a spin-off company, is highly complex, poorly documented, and little studied in emergdeveloping countries, including Brazil, (Botelho e and Almeida, 2010).

Major sporting events, because they are transprofessional, are directly linked to various economic segments, since their inherent activities require a variety of products, ranging from clothing to medical technology and infrastructural services, and it is up to society to identify and take advantage of the opportunities provided by this medium.

Because the sports production sector is 'transversal', in that it embraces a variety of different areas of knowledge in order to meet the specific demands, whether in sports education, in competitive sport or in physical activities aimed at promoting health, the learning provided by the universities to society should include teaching, research and outreach that promotes university-industry-government interaction as a means of bringing about extensive regional impact that, in practical terms, can be considered the effective entrepreneurial legacy of such sporting events (Terra et al, 2011).

In the USA and the wealthier countries of Europe, estimates of the average financial volume generated by the sports industry range between 2% and 3% (como podem variar entre 2/3 se depois citam 4/5?) of Gross Domestic Product (Proni, 2008). In the UK and the USA, for example, sport accounts for 4% to 5% of GDP, whereas in Brazil it was just 1.9% of GDP, or US$ 41 billion, in 2010, according to an IpsosMarplan survey[4]. This total embraces a broad range of factors, from the sale of sports items, events, sponsorship, promotion, patents and copyright in relation to brand licensing to investment in equipment, sporting arenas, services and wages. There is a growth possibility in this market, due to the expansion of the Brazilian economy and of the population's income level, on top of the boost for sporting activities that will occur from the upcoming mega-events.

According to data for 2010[5], in the sporting goods market, the companies Nike, Adidas, Asics, Puma, Alpargatas, Reebok, Cambuci (Penalty), New Balance and Skechers, which together hold an 80% share of the market, generate annual revenues of around R$ 4.9 billion and provide 62,000 direct and indirect jobs.
In view of the manufacturing costs, the leading companies in the sporting goods sector have chosen to produce most of their products in countries where labor is cheaper, such as Brazil, although the black market in such goods provides stern competition, particularly for licensed products (Dossiê Esporte 'Sports Dossier', 2007; apud Benazzi and Borges, 2009).

The lack of knowledge about the sport production chain raises a series of problems for Brazilian companies whose products and services are directly or indirectly linked to this segment, and it will be necessary to map out the present situation with as much precision as possible. From this map, it will be possible to see the extent of Brazilian ownership in this chain and thereby enable the setting up of knowledge transfer processes, through partnerships between Brazilian and foreign companies, backed by laws stimulating the national production of sports-related equipment and services (Alves, 2006).

According to Alves (2006), "the consumer of physical and sporting activities is the central figure in the entire growth process. It is s/he that requires the public policies, the technological and methodological innovations in the academies, the improved equipment and installations at the sports clubs, the modernization and continual renewal of sportswear (clothing, shoes, etc.); and it is s/he who determines the size and content of the media coverage, publicity and advertizing in relation to the sector. To this end, it is necessary to augment the local production of sports equipment and materials, to meet the increased demand for such items, in response to the growing practice of physical and sporting activities. This process can and should be accompanied by public policies providing incentives to Brazilian companies linked to this field".

Chias states that (2010), according to surveys in relation to the 2014 World Cup and taken into consideration in the Aquarela 2020 Plan by Marketing Turístico Internacional do Brasil, it is estimated that 500,000 foreign tourists will come to Brazil for the event. At the same time, Brazil will attract the strong interest of another 2 (two) billion plus people around the world. If we are able to inform them about the country and its innovative business potential, as well, of course, as its continental dimension and cultural and natural diversity, it will be possible to open up an international market for the production of Brazilian sporting goods and services.

Since the studies carried out in relation to the legacy of sporting mega-events include economic and technological angles, it was considered useful to conduct an assessment of the creation of academic spin offs incubated by Brazilian incubators, which would add interesting details to the existing studies, due to the specific Brazilian conditions mentioned above.

Consequently, the overall objective of this paper is to carry out an exploratory study into Brazilian academic spin offs, based on the triple helix model, that develop innovative products and services aimed at the sports market. More specifically, an effort has been made to map out the characteristics of the products and services of the spin offs in the

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[4]O Globo. Marketing Esportivo, filão que atrai estrangeiros, March 26, 2011, Availableonoglobo.globo.com/economia/marketing-esportivo-filao-que-atrai-estrangeiros-2805009.Accessed on March 20, 2012.
[5]Home page: www.move.org.br/associados.php, accessed on March 15, 2012.

sporting field that were studied, along with their sources of innovation, the financial resources received and the role of the universities and government in encouraging these innovations.

The work began with a preliminary survey, the results of which are presented herein, and the research is expected to continue over the next few years, in order to expand on the topic. The present paper is divided as follows: the first section contains the introduction; the second presents the current state-of-the-art in reference to this area; the third section presents the methodology utilized; the fourth section shows the analysis of the research results; and the fifth and last section contains the conclusions and recommendations for future public policies and research.

2. State-of-the-Art

The triple helix, which was also used as a point of reference for the methodology of this work, is a conceptual model that suggests there is a new dynamic in the relations between university, industry business and government and in the participation of each one in actions to foster innovation, using scientific research to generate new knowledge and technology (Etzkowitz and Leydesdorff, 1998).

University-business-government interaction was broadened with the introduction of a new concept, Triple Helix Spaces: Knowledge, Innovation and Consensus Spaces, which reveals the processes and mechanisms by which the institutional spheres interact and adapt over time in the striving for innovation, (Etzkowitz and Ranga, 2010).
The incubator is an example of the ideal interface structure for the activities of the triple helix players and is considered to be a hybrid organization that internalizes the relations between the three spheres, creating and fostering a space for interaction. The basic premise of the incubator is that the development of businesses can be improved by organizing it as an educational process. Within the triple helix model, the companies and cooperatives under incubation are seen as organizations that internalize the relationship between science, business and the state, stimulating the creation of an interactive space that connects those spheres (Etzkowitz, 2008).

According to Etzkowitz (2008), incubators in Brazil are considered to be an example of ‘innovation spaces’, which also generate organizational innovation practices. They perform functions related directly to economic and educational development and can also transform themselves into financing agents, which is traditionally an attribute of venture capital companies. One of the characteristics features of creating a space for innovation is that it encourages the presence of venture capital as a necessary source of investment in financial (entrepreneurial) undertakings needed to develop new products and services.

2.1.1 Entrepreneurial University
A review of the literature review about the environmental factors that affect the creation and development of the Entrepreneurial Universities, begins with the considerations of Etzkowitz, (1983) that: “Universities that are considering new sources of funding, such as like patents, research under by contracts and entry into a partnerships with a private enterprise”.

Various authors have defined the entrepreneurial university, as shown by Guerrero-Cano et al, (2006), in Table 1 below:

Table1. Principals definitions of Entrepreneurial Universities

Year	Author	D
(1983)	Etzkowitz	"Universities that are considering new sources of funds like patents, research under by contracts and entry into a partnership with a private enterprise".
(1995)	Chrisman etallapud Guerrero-Cano et all, (2006)	The Entrepreneurial University involves "the creation of new business ventures by university professors, technicians or students"
	Dillapud Guerrero-Cano et all, (2006)	"University technology transfer is defined as formal efforts to capitalize upon university research by bringing research outcomes to fruition as commercial ventures. Formal efforts are in turn defined as organizational units with explicit responsibility for promoting technology transfer"
(1998)	Clark apud Guerrero-Cano etall, (2006)	An Entrepreneurial University, on its own, seeks to innovate in how it goes to business. It seeks to work out a substantial shift in organizational character so as to arrive at a more promising posture for the future. Entrepreneurial universities seek to become "stand-up" universities that are significant actors in their own terms".
	Röpke apud Guerrero-Cano etall, (2006)	"An entrepreneurial university can mean three things: the university itself, as an organization, becomes entrepreneurial; the members of the university-faculty, students, employees– are turning themselves somehow into Entrepreneur; and the interaction of the university with the environment, the "structural coupling" between university and region, follows entrepreneurial patter"
(1999)	Subotzky apud Guerrero-Cano etall, (2006)	"The entrepreneurial university is characterized by closer university-business partnerships, by greater faculty responsibility for accessing external sources of funding, and by a managerial ethos in institutional governance, leadership and planning".
(2002)	Kirby apud Guerrero-Cano etall, (2006)	"As at the heart of any entrepreneurial culture, Entrepreneurial Universities have the ability to innovate, recognize and create opportunities, work in teams, take risks and respond to challenges"
(2003)	Etzkowitz apud Guerrero-Cano etall, (2006)	"Just as the university trains individual students and sends them out into the world, the Entrepreneurial University is a natural incubator, providing support structures for teachers and students to initiate new ventures: intellectual, commercial and conjoint"
	Jacob, etall.apud Guerrero-Cano et all, (2006)	"An Entrepreneurial University is based both commercialization (customs made further education courses, consultancy services and extension activities) and commoditization (patents, licensing or student owned start-ups)".

Source: Guerrero-Cano etall, (2006)

According to Clark (1998), the entrepreneurial university is seen to be characteristic of a social system, not of a business viewpoint. This means that the institution accepted the idea of running risks when it initiated its new practices. An entrepreneurial university seeks to be innovative, pursuing tangible change in its organizational character, with a view to attaining a new position in the future. Hence, entrepreneurial universities seek to become “stand-up” universities that are significant players in their own right. Within this context, entrepreneurship is treated as a process, rather than being considered a result. In the view of this author, there are five fundamental features that the university must seek to develop in order to become an entrepreneurial university: a clear sense of the path that is to be followed, which is accepted by not only the central administration, but also by the academic departments; that its expansion incorporates society’s demands and that the appropriate tools are created to promote these exchanges; its revenues must be diversified, so as to ensure its autonomy and sustainability; strengthening of its academic unites and an integrated entrepreneurial culture.

Etzkowitz et al (2000) called attention once again to the fact that, “… an ‘entrepreneurial university’ is a global phenomenon with an isomorphic developmental path, despite different starting points and modes of expression.”.

In the triple helix model, the entrepreneurial university is an important player in the economic and social development of the region in which it is inserted (Etzkowitz et al, 2000).

2.1.2 Spin off Firms

There is ample definition of spin off firms within the literature. According to Steffensen et al (2000), a ‘spin-off’ venture is a firm that emerges from another organization. For these authors, a spin-off can be a planned or a spontaneously created business venture. The former is a firm that results from voluntary efforts by the initiating organization. The latter is a firm that results from the effort of the academic entrepreneur, who functions subject towith little or no encouragement by the organization which that creates the spin-off firm. Following Rappert et all (1999), an academic spin-off is defined as a firm with products or services developed from a technological idea or scientific/technical knowledge originated by a member of the university who that creates the spin-off firm. Shane (2004) defines an academic spin-off as a firm created to exploit IP intellectual property derived from a research activity developed at an academic institution.

According to Botelho and Almeida (2010), spin-off firms have received a boost from the introduction of the Innovation Law, since it allows researchers to take leave from their academic activities in order to set up such a business. However, the fact that the universities still need to sort out their regulations in respect to the law and that knowledge of this legal mechanism has received limited dissemination mean that it is still a little used option.

2.13 ParticipativeGovernment

Business needs the stimulus of efficient public policies to invest in innovation and thereby raise the competitiveness of Brazilian products in the local and international markets, as well as strengthening the respective production chains (Etzkowitz et al, 2000).

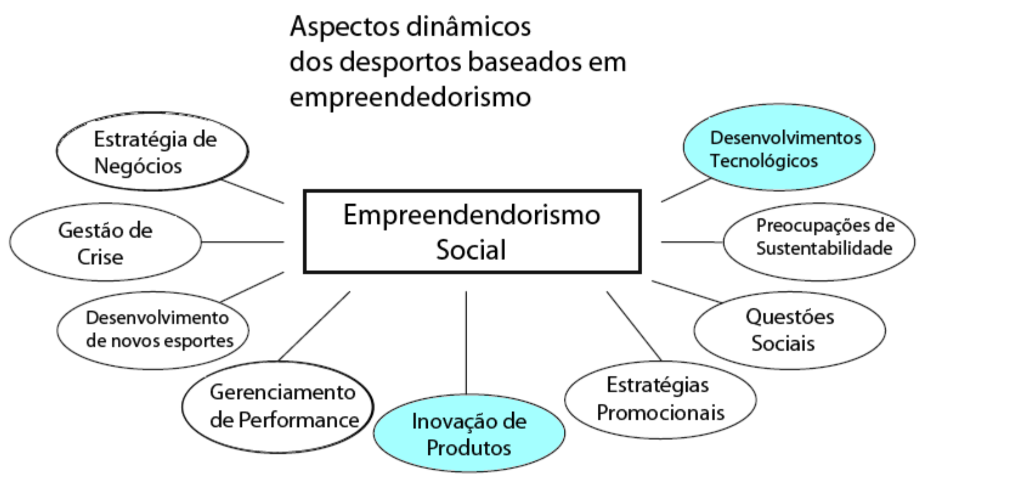
Terra (1999) affirms that the functions of a participative government are to stimulate the setting up of regional centers for S, T & I organisms; structure the S, T & I sector within a clear strategic vision; foster S, T & I infrastructure; provide partial support for the S, T & I infrastructure; legislate on intellectual property, patents, licensing and royalties; draw up specific regulations, incentives and subsidies for the S, T & I sector; create standardization, normalization, quality control and assessment mechanisms; and develop public S, T & I policies.

The elements of the public S, T & I policies are defined by the participative government, within a holistic approach geared to the national, state and regional spheres, that involves: determining goals and priorities; defining the fields of action; defining the infrastructure that will be necessary to achieving the goals; determining the factors that will influence the achieving of the goals; defining the players; defining the participation strategies; defining the decision making mechanisms; defining the mechanisms for allocating the results; defining the penalty and protection mechanisms; and determining the means for evaluating and disclosing the results.

2.2 Sport Based Entrepreneurship

Besides In addition to the related above, according to Ratten, (2011a), given the context of that "sport-based entrepreneurship is a new theory of sport management", the major innovations during the past decade have been in the use of computer statistics to help with betterimprove team performance and the internationalizeation of the interest in sports leagues.

In the view of this author, sport-based entrepreneurship involves diverse factors, such as proactive behavior, innovation and risk. These are characteristics of entrepreneurial behavior. Consequently, the bridge between entrepreneurial studies and sport may be constructed from the perspective of sport-based entrepreneurship. Thus, the theoretical framework shown in Figure 1 will facilitate an understanding of sports marketing, social entrepreneurship and technological innovation.



SOURCE: Ratten (2011b).

The study into the segmentation of the sports industry, carried out by Pitts et al (1994), concluded, based on Porter's industry segmentation theory (Porter, 1985), that this sector is important to the identification of opportunities for setting up businesses and launching products and services, as well as for evaluating business strategies. Hence, they suggested that the sports industry be divided into three segments: ***sport performance***, ***sport production*** and ***sport promotion***. Moreover, in addition to these major segments, the authors noted that there are various categories of products and types of buyers. Their definitions of the three segments are as follows: 1) ***sport performance segment*** – sport performance as offered to the consumer as a participation or spectatorial product; 2) ***sport production segment*** – those products needed or desired for the production of or to influence the quality of sport performance; 3) ***sport promotion segment***: "those products offered as tools used to promote the sport product". This segmentation was used for classifying the companies studied in this paper, as shown in Table 2.

3. Methodology

The study identified some spin-offs, in different Brazilian incubators, that are working on sporting innovations in sport. Since no survey of this kind had previously been done, the first task was to research the websites of the incubators and companies under incubation, with a view to identifying those that have produced any products in this field. A total of 384 incubator websites were investigated, involving 1,500 businesses. Of that total, it was seen that, in 136 incubators, there were 24 (twenty-four) businesses with products relating to the sports field. The survey took in the largest incubators in each state, and all regions of the country were investigated.

The survey sought to answer the following questions: 1) What new research is being conducted into sports technology by spin off firms in Brazil? 2) How many and what sporting products are being developed? 3) What is the level of innovation of the products? 4) Does the product originate from a license on an academic patent, the result of a master's or doctoral thesis, a monograph, scientific initiation, or other source? 5) Was the R&D developed in collaboration with the university? 6) What financial support was received by the company (government, venture capital, business angel)?

4. Findings and interpretation

This section shows the new research into sports technology that is being carried out by spin off firms in Brazil, how many and what sporting products are being developed and analysis of the following factors: types of products/services being offered; sources of knowledge for the development of the product/service; financial support received; and the role of the triple helix spheres (university – business – government) in generating innovation in this field. It also shows whether the items developed by the businesses that were studied originated from a master's or doctoral thesis, a monograph, scientific initiation, or other source. The financial support (government, venture capital, business angel) received by the firm, together with information on whether the product was developed under a license on an academic patent and whether the R&D was carried out in collaboration with the university are all shown in Table 2, below.

Innovations in the sporting field may involve organizational and technological factors. Organizational innovations may be related to sports teams (new strategies to increase enhance their performance);, sports organizations (Professional sports leagues) and by sports players (Ratten, 2011b).

On the other hand, technological changes can lead to a variety of sporting innovations. For example, the advances in technology in terms of engineering and new materials have led to increaseenhanced sporting achievements, as studied by Castonguay (2008) in the area of sports for the disabled sports;, the emergence of videogames and the development of videogames in the sporting field (Mullin et al, 2007), as well as innovations in equipment and technology.

Table 2, below, shows the relationship between universities and research institutes, companies and incubators, as well as the financial support received and the sources of knowledge for the innovations.

2 – The role of universities, government and spin-off firms in innovation

ty	Incubator	Spin-offFirms	Founded	Government support	Business Angel support	Venture Capitalsupport	Source of knowle
f FEI	Incubator of Technology-Based Companies-INCIT/Itajubá,MG	Tirante A	2004	FAPESP-PIPE, FINEP - Subvenção Econômica, CNPq – RHAEScholarship	Yes	–	–
f Rio UFRJ	Incubator of Technological Based Companies of COPPE/Rio de Janeiro, RJ	Controllato	2005	–	–	–	PhD Thesis.
		ARAM	2005	FAPERJ	–	–	Final graduation project and R& collaboration with the university
		Holos Brasil	1998	FAPERJ	Yes	–	Scientific Initiation Program.
sity -	Company for the Development of the Campinas High tech Hub/CIETEC Campinas, SP	Match Report	2000	FAPESP-PIPE	–	–	–
f s -	Habitare Incubator, Fundação Biominas Foundation, Belo Horizonte, MG	EDETEC	2006	FINEP – Subvenção Econômica	–	Criatec - BNDES	Patent license from the universit
f São	Center for Innovation, Enterprise and Technology - Cietec/São Paulo, SP	Initec	2010	–	–	–	–
f PB	Technology Park Foundation of Paraíba - Paqtec/Campina Grande, PB	Quatro Bordas	2008	FINEP -PRIME	–	–	–
	Technology Park Foundation of Paraíba - Paqtec/Campina Grande, PB	Tech Coach	ND[1]	FINEP - PRIME	–	–	–
ute of -	Technological Incubator-INTEC/Curitiba, PR	BioSmart	2006	FINEP – Subvenção econômica, CNPq – Bolsa RHAE	Yes	–	Master dissertation.

ersity-	Business Incubator of Santos/Santos, SP	IT & D	2004	FAPESP– PIPE, FINEP - Subvenção Econômica, SEBRAETEC	Yes	Yes	Scientific Initiation Program.
	Center for Enterprise in Science, Technology and Art - NECTAR/Recife, PE	FiTfam	ND	FINEP - PRIME	—	—	—
f -	Center for Advanced Studies and Systems of Recife - CESAR/Recife, PE	FingerTips	—	—	—	—	—
		Sophia	2006	FINEP – Subvenção econômica	—	—	—
		JynxPlaywere	2000	—			Project under the Undergraduati Entrepreneurship Course
		Meantime	2003	CNPq – Bolsa RHAE, FACEPE, FINEP – Subvenção Econômica	—	CESAR	—
f São SCAR	São Carlos Technology Park Foundation Center for the Incubation of Technology - Based Companies - CINET - ParqTec, São Carlos, SP	XBOT	2007	SEBRAETEC, FAPESP - PIPE, CNPq –Bolsa RHAE, FINEP- Subvenção Econômica	Yes	—	Post Doctoral Research.
f V	Incubator of Technology - Based Companies /Viçosa, MG	Esporte Sistemas	2008	FINEP - PRIME	—	—	Business plan, drawn up along v Computer Science Department's Enterprise and Innovation, won competition organized by the St Technology and Higher Educati SECTES, MG.
meida UVA	UVA Business Incubator/Rio de Janeiro, RJ	Rio Rally's	2008	—	—	—	—
f nta	Unisul Regional Center for Innovation and Enterprise - CRIE/Tubarão, SC	EPT Web	2009	FINEP- PRIME e FAPESC - SINAPSE	—	—	Final course project for obtainin Computer Science.
sity -	Campos Incubator of Technology - Based Companies - TEC-	FITNESS Clínica	ND	—	—	—	—

	CAMPOS/Campos, RJ						
f	Technological Development Park – Padetec/Fortaleza, CE	Nutrimax	2004	–	–	–	–
versit nde CRS	PUCRS Scientific and Technological Park - TECNOPUC	Engeltec Soluções Digitais	2006	–	–	–	–
tion	Vale do Jari Incubator of Solidarity and SustainableEco - businesses, Monte Dourado, PA	Atleta Solidário	2009	–	–	–	–

the authors.

KEY TO THE GOVERNMENT PROGRAMS (in alphabeticalorder)
CNPq - RHAE grant: The Program for the Preparation of Human Resources in Strategic Areas - RHAE was set up in 1987, under the management of the Ministry of Science, Technology and Innovation - MCTI, with the work carried out by the CNPq (National Council for Scientific and Technological Development). The RHAE program uses a variety of different kinds of Technological Development grants, specially created to attract highly qualified individuals to perform R&D activities in companies, as well as developing human resources for work on applied research or technological development projects.
Criatec - BNDES: A seed capital Investment Fund for innovative new companies, which came about through a BNDES (Brazilian Development Bank) initiative and is maintained by a consortium of service providers comprising Antera Gestão de Recursos S.A. and the Grupo Instituto Inovação S.A (controller of In Seed Investimentos Ltda.). The objective is to obtain capital gains through long-term investments in start-ups (including pre-start up) with an innovative profile that offer a high return (Source: http://www.fundocriatec.com.br/, Accessed on April 20, 2012).
FACEPE: Various calls to tender by FACEPE (Foundation in Support of Science and Technology in the State of Pernambuco) (Source: http://www.facepe.br/, Accessed on April 20, 2012).
FAPERJ: Various calls to tender by FAPERJ (Carlos Chagas Filho Foundation in Support of Research in the State of Rio de Janeiro) (Source: www.**faperj**.br/, *Accessed on April 20, 2012).*

FAPESC – SINAPSE: FAPESC (Foundation in Support of Scientific and Technological Research in the State of Santa Catarina) and SEBRAE/SC (Brazilian Service for the Support of Small Enterprises in the State of Santa Catarina) launched the program “Sinapse da Inovação”, which will provide around R$ 50,000 each to up to 100 firms to develop innovative products or processes. The program was conceived with the intention of transforming and applying good ideas from students, researchers and professionals in different fields of knowledge (Source: http://www.fapesc.sc.gov.br/, Accessed on April 20, 2012).

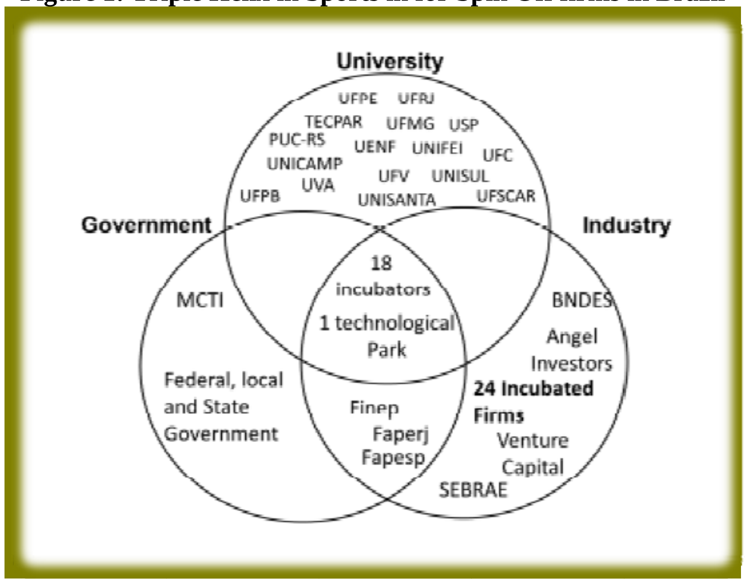
FAPESP-PIPE: FAPESP (Foundation in Support of Research in the State of São Paulo) launched the Program FAPESP - PIPE (Innovative Research in Small Enterprises) in 1997, which is aimed at supporting scientific and/or technological research in small enterprises based in the state of São Paulo. Research projects selected for support under the PIPE must be developed by researchers who have an employment link with a small enterprise or are associated with it for the purpose of the project (FONTE: http://www.fapesp.br/, Accessed on April 20, 2012).

FINEP - Economic Subsidies: The purpose of the FINEP (Funding Agency for Studies and Projects) Economic Subsidy is to promote a significant increase in innovative activities and enhance the competitiveness of the country’s businesses and economy in general. This new financial support format allows public resources to be applied directly to companies on a non-reimbursable basis (they do not need to be repaid), thereby sharing the costs and risks inherent in such activities. The framework that allowed the granting of economic subsidies was established upon approval of Law no 10,973, of December 2, 2004, regulated by Decree no 5,563, of October 11, 2005 (Innovation Law and regulations) [Brazil, 2004 and 2005] and Law no 11,196, of November 21, 2005, regulated by Decree no 5,798, of June 7, 2006 (LEI DO BEM Law and regulations) [Brazil, 2006]. This new scenario was created to promote innovation in the country’s businesses and FINEP, a public entity linked to the Ministry of Science and Technology, is its principal agent (Source: http://www.finep.gov.br/programas/subvencao_economica.asp, Accessed on April 20, 2012).

FINEP - PRIME: The Primeira Empresa Inovadora - PRIME program was launched by FINEP at the beginning of 2009. The objective is to create favorable financial conditions for a significant number of high added value start-ups to be able to successfully consolidate the initial phase of the development of their enterprise (Source: http://www.finep.gov.br/programas/prime.asp, Accessed on April 20, 2012).
SEBRAETEC: The program SEBRAETEC - Serviços em Inovação e Tecnologia is an instrument of the SEBRAE System that allows firms access to existing technological know-how within the S, T & I infrastructure, with a view to improving the processes and products and/or introducing innovations in companies or in the market (Source: http://portal.pr.sebrae.com.br/sebraetec/Conteudo.do?codConteudo=0, Accessed on April 20, 2012).

A visual representation of the interaction between university – business - government in the creation of spin offs whose products and/or services include those dedicated to opportunities in the sporting field can be seen in Figure 2, below.

Figure 1: Triple Helix in Sports in for Spin Off firms in Brazil



Source: the authors.

The companies need the incentives provided by efficient public policies to be able to invest in innovation and thereby raise the competitiveness of Brazilian products in both local and international markets, as well as strengthening the respective production chains (Kolt, 2011).

The elements of the public policies for S, T & I will be defined by the participative government, as part of a holistic approach geared to the national, state and regional spheres, and involves: determining the goals and priorities; defining the fields of action; defining the infrastructure that will be necessary to achieving the goals; determining the factors that will influence the achieving of the goals; defining the players; defining the participative strategies; defining the decision making mechanisms; defining the mechanisms for allocating the results; defining the penalty and protection mechanisms; and determining the means for evaluating and disclosing the results. A perfect example of the role of the government in the development of research that generates innovations in the sporting field and in supporting start-ups in this field is the activities of FINEP. A FINEP has invested around R$ 10 million over the last three years in research in the sporting field in 2007, (under the financial grants program) and launched the 2014 BIS Program in October 2010, with a view to supporting initiatives linked to the Soccer football World Cup and Summer Olympic Games that Brazil will be hosting.According to FINEP (2010): “This is an opportunity and an incentive to develop Science & Technology, so that the country can finally become a player in this field, and not merely a buyer of sporting events and solutions”, in the words of Ricardo Avellar, general coordinator of Sporting Excellence at the National Department for Competitive Sports, in Brazil.

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In 2010, FAPERJ launched the program "Support for the Development of Sporting Innovations in the State of Rio de Janeiro – 2010”. The call for tenders was aimed at universities, businesses and independent inventors, with the objective of supporting scientific and/or technological projects that innovate in the preparation of athletes, training of coaches or development of sports-related equipment, for the purpose of helping to spread the practicing of sports; introducing quality in the practicing of sports; training and updating of the techniques and knowledge of sports coaches; improving the infrastructure needed for the practicing of sports; and developing equipment and technological solutions, all in the state of Rio de Janeiro, (FAPERJ, 2011). One of the firms that received this support is Holos, a previously above mentioned spin-off for the task of building a carbon fiber mast for the Finn racing class of yachts.

In addition to the specific programs mentioned above, the information collected from the companies under incubation leads to the conclusion that other, non-reimbursable sources of funding provided by FINEP (Economic subsidies and PRIME) and state agencies (FAPESP, FACEPE) have been used by the firms to obtain resources for innovation.
The Brazilian spin-offs identified in this research of the websites of the incubators and in interviews develop a variety of products/services in the sporting field. The diversity of these products/services shows the different opportunities that have been identified in the industry devoted to the sporting field in Brazil. These products/services are shown in Table 3, below, using the sports industry segmentation developed by Pitts et al (1994).

Tabela 3 – Spin offs na área de esportes

Sport Industry Segment (Pittset all. (1994),	**Empresa**	**Equipment/Service**
sport production (71%)	Initec	***equipment***: mouth protector for sports competitions
	Tirante A	***equipment***: flight instrument that can be used in gliding, paragliding and hang gliding
	HolosBrasil	***equipment***: sailing boat class
	ARAM	***sport facility***: sports facility: technology for creating artificial waves that are ideal for surfing
	Controllato	***sport facility***: the measuring of the fans' impact on the stadium's concrete structure
	BioSmart	***Medicalcare***: Advanced rehabilitation systems
	EDETEC	***Medicalcare***: products for clinical and sports nutrition, used by the food industry
	Nutrimax	***Medicalcare***: nutritional supplements
	Quatro Bordas	***Performanceproduction***: performance production: system of evaluation for competitive sports, notably swimming
	Esporte Sistemas	***Performanceproduction***: sistema de Avaliação física e prescrição esportiva
	IT & D	***Performanceproduction***: performance production: system of physical evaluation and sports prescription
	Tech Coach	***Performanceproduction***: products for assessment and training, in real time, of on-field movement and the performing of tactical moves, for football players
	Match Report	***performance production***: software for "scout"
	EPT Web	***Performanceproduction***: system of physical/nutritional evaluation and prescription
	FitFam	***Fitnesstrainer***: physical training in companies, including sporting events, calisthenics and physiotherapy
	FITNESS Clinica	***Fitnesstrainer***: sporting advice
	Atleta Solidário	***Fitnesstrainer***: promoting social inclusion through sport, for people with visual, intellectual, physical, hearing or multiple disabilities sport performance
sport performance	Engeltec Soluções Digitais	***Sport spectating***: producing customized electronic gadgets for use in a variety of corporate environments, including the sale and control of tickets for events and shows
	Sophia	***Sport spectating***: a 'virtual' narrator of football games, via mobile phone sport promotion
Sport promotion	FingerTips	***tool***: smartphone apps for the sporting field

	JynxPlayware	***tool***: sports games for mobile and smartphones
	Meantime	***tool***:sports games for mobile and smartphones
	XBOT	***tool***:games - Rogobol, using robotics
	Rio Rally's	***tool***:events, events, like tourism, cultural, historical, ecological and adventure circuits

Source: the authors.

Of the 24 companies, one can see that 17, equivalent to 71% of the total, are active in the Sport production segment, which may be sub-divided into the following product categories: 1) out fitting products: equipment and apparel; and 2) performance production products: Ffitness trainer, medical care, Ssports facilities and governing bodies. In the sport production segment, outfitting products category, it can be seen that three companies are dedicated to producing equipment. Two of these companies develop equipment for sporting segments that are of more limited public access in Brazil: gliding and sailing. This choice may be partially explained as taking advantage of opportunities in market niches, since, as mentioned previously, the major international companies have an 80% share of the Brazilian market for traditional sporting goods, making it hard for new companies to penetrate this sector, particularly when they are small ones. (outra explicação é que são mercados onde os praticantes têm maior poder aquisitivo, assim permitindo a recuperação mais rápida do investimento financeiro)

Meanwhile, tThe firm Holos Brasil appeared in 1998, as a result of the enthusiasm of two young students in the UFRJ`s Marine Engineering Projectgram, who were motivated by their experience in the Scientific Initiation Program, where they had built a wooden snipe class sailing boat for the Snipe class, one of the Pan-American Games' yacht racing categories. The same year the company was set up also saw the emergence of the UFRJ nautical center, a Marine Engineering Department initiative, with which the company has a close partnership. The first project was finalized in 2002: the Double Canoe, a rowboat for two people. Then, in 2004 was a big growth year for the dinghy project, which enabled the financing of an even more ambitious project: the Emi, a 4.7 meter yacht. After nearly two years of research, planning and development, and testing and adjustments on a prototype, the production molds were finalized and a new Brazilian sailing boat class was publicly launched in 2006.

Another example is Tirante A, a firm hosted by the INCIT, as a tool for the UNIFEI entrepreneurship program from UNIFEI, which was set up in 2004 and comprises pilots and electronics engineers with years of experience in electronics projects, who are trying to provide for the needs of those practicing unpowered flight. The first product launched by Tirante A was the TAV-1000, a flight instrument that can be used in gliding, paragliding and hang gliding. The first instrument of its kind to be developed and manufactured in Brazil, the TAV-1000 helps to identify air currents and provides the pilot with data regarding altitude, take off, temperature and flight duration. The success of this product, which took three years to develop, has encouraged the entrepreneurs to work on new products. The next model, the TAV-1500, which is in the process of development, is a new digital variometer with specific functions for competitions. The company's aim is to augment production, consolidate its position in the Brazilian market and pave the way for exports. Having completed its incubation period, the company established itself in the São José dos Campos technological park, in the state of São Paulo, which is a major hub for ecotourism and technological development in Brazil.

The third company in this category is developing a product that is intended to offer superior quality to the local brands, yet at a lower price than the imported equivalents. Once Initec, incubated at USP's Cietec, had demonstrated the possibility of developing local products that were more economically accessible, this stimulated other companies to also create new products in this field. (tentei fazer sentido da segunda frase - espero que acertei)

Remaining with the Sport production segment, outfitting products category, it was noted that, of the 14 companies classified under performance production, six of them develop fitness trainer products/services and three in medical care, while another two provide services in the sports facilities field.

The fitness trainer companies are dedicated to strength and conditioning coaching and carry out activities in the coordination of athlete's' fitness, conditioning, and the sport training program. Analysis of the products/services offered by these companies shows that six of them are active in the sector of sports performance segment, for the purpose of analyzing and evaluating information in key areas related to improved athletic performance.

Match Report develops a software for "scouts", which analyzes the moves during football matches, for the purpose of identifying the tactics employed by opposing teams. The company appeared in 2000, founded by economics and computer engineering students at UNICAMP and computer engineering students at the Catholic University of Campinas – PUC/Campinas, and is under incubation at UNICAMP's CIATEC, from UNICAMP.

The other three companies studied provide sports instruction and training services. Notable among them is the Athlete Solidarity Program of the Orsa Group's Vale do Jari Incubator of Supportive and Sustainable Eco-businesses, which promotes social inclusion through sport, for people with visual, intellectual, physical, hearing and multiple deficiencies.

Of the medical care companies, two of them produce nutritional supplements for athletes, while the other operates in the field of rehabilitation. One of the nutritional supplement companies is Edetec, of the Biominas Foundation's Habitare Incubator, whose product arose from technology transferred from UFMG and the quest for a product developed in Brazil that would offer improved characteristics in relation to the imported product.

BioSmart, operating in the field of rehabilitation, is under incubation at TECPAR's INTEC. The company came about as a result of the widespread acceptance and recognition within the scientific community of Leonardo Rodrigues da Silva's master's thesis. Having presented his research results at a European congress on rehabilitation, he was encouraged by other researchers in the fields of Biomedical Engineering and Rehabilitation Engineering to launch a product developed from the results of his investigations.

Some spin-offs developed work for the 2007 Pan-American Games in Rio. One example is Controllato, created in 2005 with the participation of the COPPE incubator from at the UFRJ. This company originated at in the civil engineering program's Structural Laboratory and it is the fruit of a partnership between one of the professors and a student studying for a doctorate. The company has conducted a study on behalf of the consortium responsible for renovating the Maracanã stadium, in the city of Rio de Janeiro city. The aim of the study was to assess the fans' impact on the stadium's concrete structure. To avoid problems arising from the fans' exuberant celebrations, the company installed multiple synchronized dynamic attenuators, which absorb the energy released by the fans.

There are five companies in the sport promotion segment. One of these is a company that organizes sporting events, while the other four stimulate the practicing of sports through the development of applications for smartphones that simulate games. Just as new technology, such as sport video games, has introduced innovations in the field of sport, sport video games have become the third most popular type of video game (Mullin et al, 2007). And innovations arising from the development of smartphones and mobile telephony have provided incentives for the creation of products for this sub-sector. The possibilities for exploring this market, both in Brazil, with the expansion of the mobile telephony, and abroad will enable the accumulated knowledge and capacity in the software production field to be used to create products for the sporting field, as in the case of the firms JynxPlayware and FingerTips.

With regard to the analysis of the level of innovation in the products/services, this was done according to OECD concepts (1997). It was seen that there was no product that was completely innovative, in global terms, but that they could be considered as innovative from the point of view of Brazil. It is believed that this is the reason why 15 (fifteen) of the twenty-four companies studied have received financial support from government agencies for the development of innovations.

This is similar to the results of the Technological Innovation Survey 2008 – PINTEC, carried out by the IBGE (Brazilian Institute of Geography and Statistics) for the purpose of analyzing the technological innovation activities of Brazilian companies. That survey showed that, of a total of 106,800 companies, around 41,300, equivalent to 38.65%, introduced a new or substantially improved product and/or process between 2006 and 2008. However, it was ascertained that 32.10% informed that their innovation was in progress, with the acquisition of machinery and equipment still taking place (IBGE/PINTEC, 2008). The rate of innovation of new products in the Brazilian market is 4.10%, while the rate of innovation of new processes in the domestic market is 2.32% (IPEA, 2011). So, although the spin-off firms developing innovative products and services for the country may be included amongst the limited number of innovative Brazilian companies, it can be seen that they have been unable to alter the national scenario revealed in previous surveys.

5. Conclusion: policy implications and directions for further research into sports entrepreneurship in Brazil

The expansion of business in the sporting field shows that there are many opportunities in this area for entrepreneurs. The winners in this market are technology-based companies with innovative ideas. The president of the Brazilian Olympic Committee - COB, Carlos Arthur Nuzman, has observed that, "With each Olympic cycle we can see that sport and technological innovation are increasingly inter-related" (Horn, 2007).

Although sport in Brazil has been studied in relation to a variety of different areas, including: Physical Education, Management, Health, Physiotherapy, Marketing, Sociology, Philosophy and Psychology, there is still a gap in regard to innovation and entrepreneurship aimed at business opportunities, which we are attempting to address in this paper, through the analysis of academic spin-offs.

The research results indicate that the universities were the sources of knowledge for some of the firms to develop their products or business model. Furthermore, it was ascertained that the vast majority of the firms obtained non-reimbursable resources or grants in support of their research, in order to be able to develop their products. In this role, the structures set up by the universities - the incubators – collaborated towards this end, with both management support and in the consolidation of the undertaking, which, effectively, increased the firms' chances of success.

Within the sporting economic sphere one should also consider other sports that do not feature in the Olympic scenario, yet offer a fertile environment for the development of innovative business ideas.

We trust that this paper has contributed towards progress in the scenario considered herein, by presenting an analysis of the creation of new enterprises based on products and services developed by academic spin offs that are part of the incubation programs supported by universities.

It is hoped that the results of this analysis help to highlight the potential of this association in promoting the development of projects through this partnership, as well as in more extensive analysis of the technological capacity for innovation and market opportunities to guide the creation of new products.

References

Alves, J. A. B.. 2006. **Cenário de Tendências Econômicas dos Esportes e Atividades Físicas no Brasil**. IN: DaCosta, L. (ORG.). Atlas do Esporte no Brasil. Rio de Janeiro: Conselho Federal de Educação Física - CONFEF.

Anprotec. Associação Nacional de Entidades Promotoras de Empreendimentos Inovadores. 2004.Panorama. Available http://www.anprotec.org.br/ArquivosDin/panorama_final_pdf_09.pdf, accessed on April, 4^{th} , 2012.

Anprotec. Associação Nacional de Entidades Promotoras de Empreendimentos Inovadores.2012. **Um novo Retrato**. Revista Locus. Ano XVII (65), 46 - 47.

Benazzi, J. R. S. C. and Borges, C. N. 2009. **Emoção, Exposição e Vendas: análise do patrocínio realizado por marcas de artigos esportivos no futebol brasileiro**. In: VI Simpósio de Excelência em Gestão e Tecnologia, 2009, Resende. Anais do VI Simpósio de Excelência em Gestão e Tecnologia - SEGET. Resende: Associação Educacional Dom Bosco. Availableonhttp://ww.aedb.br/seget/artigos09/147_Marketing%20no%20esporte%20final%20com%20autores.pdf. Accessed on March, 03, 2012.

Botelho, A. J. J. and Almeida, M. 2010. **Overcoming institutional shortcomings for academic spin-off policies in Brazil**.InternationalJournalof Technology Management &SustainableDevelopment.9(3), 175 -193.

Brasil, Decreto nº 5.563 de 11 de outubro de 2005. **Regulamentação da Lei de Inovação**. Disponível em: < www.planalto.gov.br/ccivil_03/_ato2004-2006/2005/.../d5563.htm>. Acesso em: 20 abr. 2012.

Brasil, Decreto nº 5.798 de 07 de junho de 2006. **Regulamentação da LEI DO BEM**. Disponível em < www.planalto.gov.br/ccivil_03/_ato2004-2006/2006/.../D5798.htm >. Acesso em: 20 abr. 2012

Brasil, Lei nº 10.973 de 2 de dezembro de 2004. **Lei da Inovação**. Disponível em: <www.planalto.gov.br/ccivil_03/_ato2004-2006/.../**lei**/l10.973.htm>. Acesso em: 20 abr. 2012.
Brasil, Lei nº 11.196, de 21de novembro de 2005. **Lei do Bem**. Disponível em < www.planalto.gov.br/ccivil_03/_ato2004-2006/.../lei/l11196.htm>. Acesso em: 20 abr. 2012

Brasil, **Plano Brasil Maior (2011 – 2015).** Disponível em: <www.brasilmaior.mdic.gov.br/>. Acesso em: 20 abr. 2012.

Brasil, **Política de Desenvolvimento Produtivo – PDP** (2008-2010). Disponível em <*www.mdic.gov.br/pdp/index.php/sitio/inicial*>. *Acesso em*: 20 abr. 2012.

Brasil, **Política Industrial, Tecnológica e de Comércio Exterior – PITCE** (2003-2007). Disponível em <www.ipea.gov.br/005/00502001.jsp?ttCD_CHAVE=148>. *Acesso em*: 20 abr. 2012.

Castonguay, S. and Jewell, C. 2008.**Technology, innovation and grit: Faster, higher, stronger in disabled sports**. WIPO Magazine, N.. 4. Available on http://webcache.googleusercontent.com/search?q=cache:http://www.wipo.int/wipo_magazine/en/pdf/2008/wipo_pub_121_2008_04.pdf. Accessed on March, 20, 2012.

Chias, Josep. **Brasil 2014: uma visão a partir do marketing e do turismo**. Available on:http://www.gramado.onde.ir/component/content/article/8-variadas/1501-brasil-2014-uma-visao-a-partir-do-marketing-e-do-turismo.Accessed on 09 de March, 9, 2010.

Clark, B.R., 1998. Creating Entrepreneurial Universities: Organizational Pathways of Transformation (Issues in Higher Education), vol. 12.Pergamon Press, London.

DaCosta, L. P., Correa, D., Rizzut, E. Villano, B (Editores). 2008. **Legados de Mega eventos esportivos**. Brasília: Ministério dos Esportes.

Etzkowitz, H. (1983). **Entrepreneurial Scientists and Entrepreneurial Universities in American Academic Science**.*Minerva,* 21(2-3): 198-233.

Etzkowitz, H. 2008. **The Triple Helix: university-industry-government, Innovation in Action**. Routledge, New York, London.

Etzkowitz, H., Mello, J. and Almeida, M. 2005. **Towards "meta-innovation" in Brazil: the evolution of the incubator and the emergence of a triple helix**, Research Policy, Vol. 34(4), 411–424.

Etzkowitz, H., Webster, A., Gebhardt, C., Terra, B. 2000. **The future of the university and the university of the future: evolution of ivory tower to entrepreneurial paradigm**. Research Policy, 29 (2), 313–330.

Etzkowitz, H.; Leydesdorff, L. 1998.**The endless transition: A "triple helix" of university- industry-government relations**. Minerva, 36 (3): 203-208.

Etzkowitz, H.; Ranga M. 2010.**A Triple Helix System for Knowledge-based Regional Development: From "Spheres" to "Spaces"**. Theme paper for Triple Helix 8 International Conference, Madrid, October 2010, Disponívelem: http://www.triplehelix8.org/downloads/Theme-Paper.pdf.Accessed on September, 25, 2010.

FAPERJ. Editais 2011. **Home Page Institucional**. Disponível em <www.**faperj**.br/>. Acesso em 20 de abril de 2012.

FINEP, Financiadora de Estudos e Projetos. 2010. **De olho no pódio, Brasil investe em tecnologias esportivas**. Revista Inovação em Pauta – Capa: Esportes, Número 8.
Guerrero-Cano, M.; Kirby**,** D.; Urbano, D. **A LiteratureReviewonEntrepreneurialUniversities: AnInstitutional Approach.** 3rd Conference of Pre-communications to Congresses.Business Economic Department.AutonomousUniversityof Barcelona.Barcelona, June 2006.

Horn, D. 2007. **Corrida pela inovação**. Locus - Ambiente da inovação brasileira, N° 49, Ano XIII.

IBGE. Instituto Brasileiro de Geografia e Estatística. **Pesquisa de Inovação Tecnológica – PINTEC**, 2008.
IPEA. Instituto de Pesquisa Econômica e Aplicada. 2011. **Trajetória Recente dos Indicadores de Inovação no Brasil**. Textos para Discussão nº 1659.

Kolt, G. S. 2011. **Editorial Innovation and translation in sports medicine and sports science research**. Journal of Science and Medicine in Sport 14 (2), 93 – 94.

Mullin, B., Hardy, J., and Sutton, W. 2007.**Sport marketing** (3rd Ed.). Champaign: Human Kinetics.

OECD.Organization for Economic Co-operation and Development.**Oslo Manual**.1997.
Pitts, B., Fielding, L. and Miller, L. 1994. **Industry segmentation theory and the sport industry: developing a sport industry segment model**. Sport Marketing Quarterly [SMQ], 3(1), p. 15 - 24.

Porter, Michael E. Competitive Advantage. 1985. The Free Press. New York.

Proni, M. W. 2008. **Economia do esporte: um campo de estudo em expansão**. 1º Encontro da ALESDE: Esporte na América Latina: atualidade e perspectivas, UFPR - Curitiba - Paraná – Brasil 30, 31/10 e 01/11/2008. Available on: www.alesde.ufpr.br/encontro/trabalhos/48.pdf. Accessed on January, 10, 2012.

Rappert, B., Webster, A. and Charles, D. 1999. **Making sense of diversity and r**eluctance, Research Policy, 28(8), p. 873–90.

Ratten, V. 2011a.**Sport-based entrepreneurship: towards a new theory of entrepreneurship and sport management**. International Entrepreneurship and Management Journal, 7 (1) 57 – 69.

Ratten, V. 2011b.Social entrepreneurship and innovation in sports. International Journal of Social Entrepreneurship and Innovation, 1(1), 42 - 54.

Shane, S. 2004. Academic **Entrepreneurship: University Spin-offs and Wealth Creation**, Northampton, MA: Edward Elgar.

Spilling, O. R. 1996.**The entrepreneurial system: On entrepreneurship in the context of a mega-event**. Journal of Business Research, 36(1), 91–103.

Steffensen, M., Rogers, E. M, and Speakman, K. 2000.**Spin offs from research centers at a research university**, Journal of Business Venturing, 15(1), 93–111.

Terra, B. 1999. **Escritórios de Transferência de Tecnologia em Universidades e Institutos de Pesquisa Públicos: Uma Proposta Institucional**. Tese de Doutorado UFRJ/COPPE/PEP/ITOI, setembro de 1999.

Terra, B., Batista, L. A., Almeida, M., Campos, S. R. C. 2011. **A oportunidade de inovação no esporte é nossa!** Polem!ca, Vol. 10 (1), 74 – 90.

CREATING A WEB INFRASTRUCTURE OF THE REGIONAL INNOVATION ECOSYSTEM IN THE TRIPLE HELIX MODEL IN RUSSIA

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Abstract
This research attempts to find out the following issues: who is interested in the establishment of innovative economy infrastructure in the Internet; what technologies can be used in development of innovative infrastructure development in the Internet; what is the role of services and web sites in the development of innovation regions; is it possible to integrate services and web-sites of universities, businesses and regional authorities into a single web infrastructure.

Keywords: semantic web; infrastructure; innovation ecosystem

THE TRIPLE HELIX MODEL FOR FRUITS AND VEGETABLES SUPPLY CHAIN MANAGEMENT DEVELOPMENT INVOLVING SMALL FARMERS IN ORDER TO FULFILL THE GLOBAL MARKET DEMAND: A CASE STUDY IN "VALUE CHAIN CENTER (VCC) UNIVERSITAS PADJADJARAN"

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Abstract

Demand for fresh fruit and vegetable (FFV) is increasing as the rise of income per capita in some Asia Pacific countries, such as South Korea, Taiwan, and China, which are currently importing from South East Asia countries. Singapore is also the biggest importer country of FFV product, but only 6% of its market share can be taken by Indonesia. The major problem is the difficulty in meeting export quality standard of Indonesian agricultural product. To overcome this problem, institutional innovation is required so that supply chain management of FFV products can be improved. This paper discussed about the application of "triple helix model" on interaction between universities, exporters, government, and supporting institutions in developing FFV supply chain management. This study was using case study method on triple helix model developed by Value Chain Center of Universitas Padjadjaran. Causal Loop Diagram as a part of system thinking approach was used as the analysis tool. Results indicated that multi-stakeholders interaction opens the opportunity for FFV farmers to get involved in supply chain of export market. Institutional innovation has a role as a risk reducer that provides supporting services to the farmers in order to meet export market demand.

Keywords: Institutional Innovation; triple helix model; supply chain management

AN ASSESSMENT OF THE CAPABILITY OF ICT EDUCATION IN BICOL UNIVERSITY POLANGUI CAMPUS, POLANGUI, ALBAY, PHILIPPINES:A DETERMINANT TO ITS SUSTAINABILITY

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Abstract
The 21st century poses an urgent need for the integration of ICT in classroom instruction. Education is a lifelong process therefore access to information anytime, anywhere is imperative. We need IT literates to meet the challenges of illiteracy and poverty and bring about the cost reduction of education, improve the quality and effectiveness of teaching (wikieducator,n.d.). This paper intends to present the results of an assessment on the capability of ICT education where its sustainability largely depends upon it. Specifically, it aimed to determine the profile of the ICT facilities, Faculty Readiness in ICT Literacy, ICT-related researches, budgetary allocation for ICT facilities and linkages with non-government and government agencies. Likewise the level of capability of ICT education was assessed. Findings revealed that the school has the capability to sustain ICT education. The conclusion that capable and sustainable ICT education would produce ICT literate individuals who would meet the challenges of the digital world was advanced.

Keywords: ICT, Capability, Sustainability, New Literacy

Introduction

There are varied reasons why Information Communication Technology is an urgent need in the educational system. Firstly is that education is a lifelong process therefore anytime; anywhere access to it is imperative. Information explosion nowadays is a phenomenon so access to it is necessary. Our present society requires individuals who are IT literates to increase access and bring down the cost of education to meet the challenges of illiteracy and poverty and ICT is the answer.

ICT plays a very important role in education because it provides a variety of learning resources and with abundant resources, teaching and learning skills are enhanced. With the of use technology, learners are able to communicate ideas, describe projects and order information in their work.

ICT provides immediacy of information. With the use of computers and the web networks the pace of imparting knowledge becomes very, fast where one can be educated anywhere, anytime.

Further, It provides audio-visual materials which conforms with the theory in psychology of learning that, the higher process of memory and concept formation basically start with perception where the senses gain information from the environment. Through ICT audio –visual materials has become so abundant. Information in the net is purely correct and up to date

The central matter therefore of ICT in teaching in order to ensure quality in our educational system is to make students familiar with the use of ICT since all jobs in the future will be dependent on it and it must be used in teaching in order to improve the quality and effectiveness of teaching(wikieducator retrieved from http:/wikieducator.org)

According to Wayan Vota(n.d.)sustainability on the other hand is the ability of an educational ecosystem to maintain scholastic process, functions, diversity and productivity into the future. Further, monetary aspect is not the only thing that matters with sustainability but actually creating community ownership to the point of local customization in implementation and self-propagating growth and expansion.

Thus if we develop and apply ICT badly it could add to the world's problems, could devour energy and accelerate climate change, worsen inequality for those who dot have access and increase pollution and resource use by encouraging more frenetic consumerism. On the other hand if applied well the rewards is enormous. I t could help enhance creativity and innovation to solve our problems build our community, give more people access to goods and services and use precious resources much more efficiently (Madden & Weibrod,2008)

The Study

This research was focused in assessing the capability of ICT Education in Bicol University Polangui Campus, Polangui Albay, Philippines during the first semester of SY 2010-2011.

It was an outgrowth of a previous research in 2006 of the same author on Teacher's Readiness For and Their Attitude Toward New Literary. Result of this previous study revealed that the teachers of the same school were not ready to integrate ICT in their instruction and that they have fear and anxieties to use ICT specifically, the internet.

The present study aimed to assess the capability of ICT Education on the assumption that capability is a prime factor to sustain ICT Education.

Specifically it aimed to determine the profile of ICT facilities, the teacher's readiness in integrating ICT in instruction in terms of training, use of the computer, the Internet, the school's budgetary allocation for ICT Education, ICT-related researchers, non-government and government support and the level of capability of ICT Education in BUPC.

The Descriptive-Survey Method of Research was employed and two instruments were used in gathering the data where Instrument 1 was a questionnaire on the capability of ICT facilities, Instrument 2, a questionnaire to determine the teacher's readiness to integrate ICT in instruction in terms of their training, use of ICT facilities and their competence in ICT skills. Likewise an interview with the Dean was made to get information regarding the sources of budgetary allocation for ICT education.

To gather data regarding ICT-related researches, documentary analysis of the research files in the Research Office was made. There were 88 respondents who were randomly selected from a total population of 123 faculty of the school. Findings and recommendations of this research is delimited to the school and its faculty only which is the subject of this study.

Findings

An assessment of the ICT facilities where data were provided by the ICT Coordinator revealed that the institution is equipped with three(3) ICT lecture rooms, three(3) ICT laboratory rooms, seventy(70) computer units in the computer laboratory, eighteen(18) computer units in the internet laboratory, four(4) LCD projectors, one(1) digital camera, two(2) video cameras, four(4) computer units in the library and three(3) in the research office. These figures connotes that BUPC has for its start in ICT education sufficient facilities in contrast with the statement of an education official who said that there is really nothing going on as regards ICT education.

The levels of training of the faculty is reflected in Figure 1. It is observable that the faculty in Computer and Engineering Department has the highest percentage in Level 3 training. This result is an affirmation that teachers in this department are truly ICT literates. Fifty percent (50%) of the faculty have finished ICT course and/or Degree holders in computer education with advanced skills and trainings. In Level 2 trainings, faculty in the Education Department registers forty six percent (46%) among the other departments. These are the teachers who obtained the basic training in ICT with additional short-term trainings/seminars. These group of teachers are literates the fact that they have both the basic and additional trainings in ICT. In Level 1, forty percent (40%) faculty from the education department have undergone basic training in ICT. The biggest number of faculty who don't have any training in ICT are those belonging to the Nursing and Health Sciences Department. These implies that teachers must be literate in the new technology because students learn best in a classroom where the teacher themselves are experts (Snow, W. Burns,R. and Griffin,F. 1998)

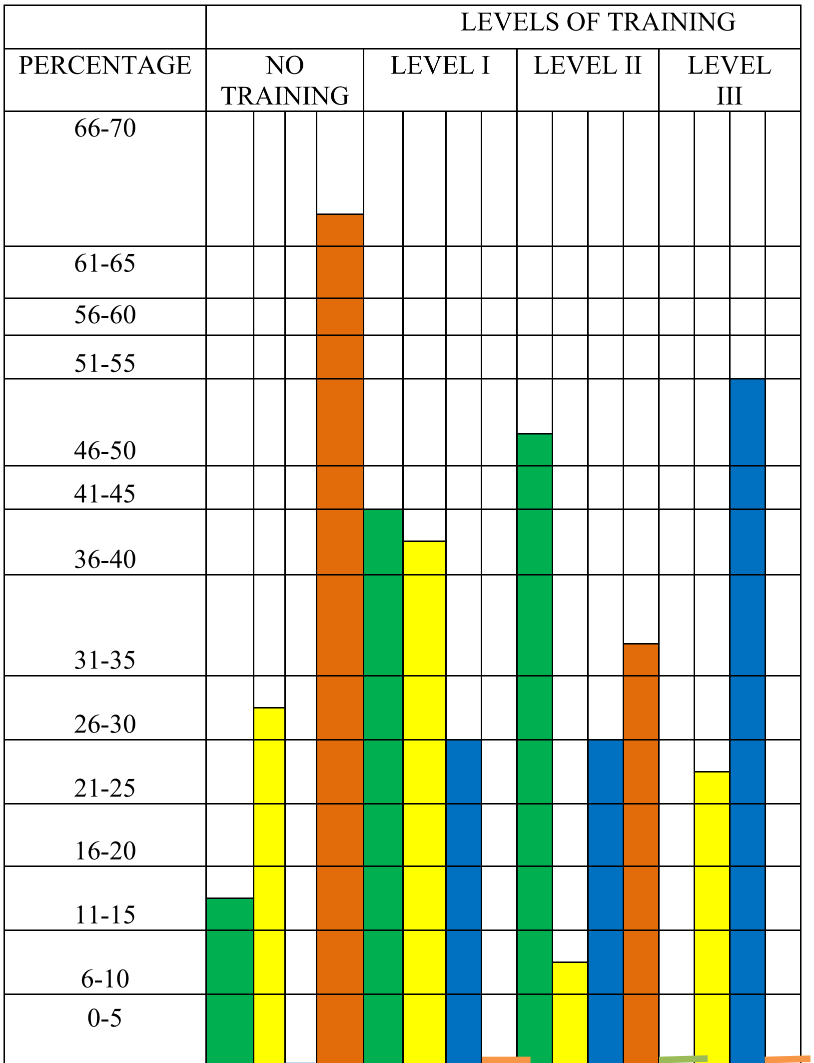

Figure 1: Shows the Teachers' Readiness in ICT Literacy according to Training (by Department)

LEGEND:

Education Department
Com er Studies and Engineering Department
Technology Department
Nursing and Health Sciences Department

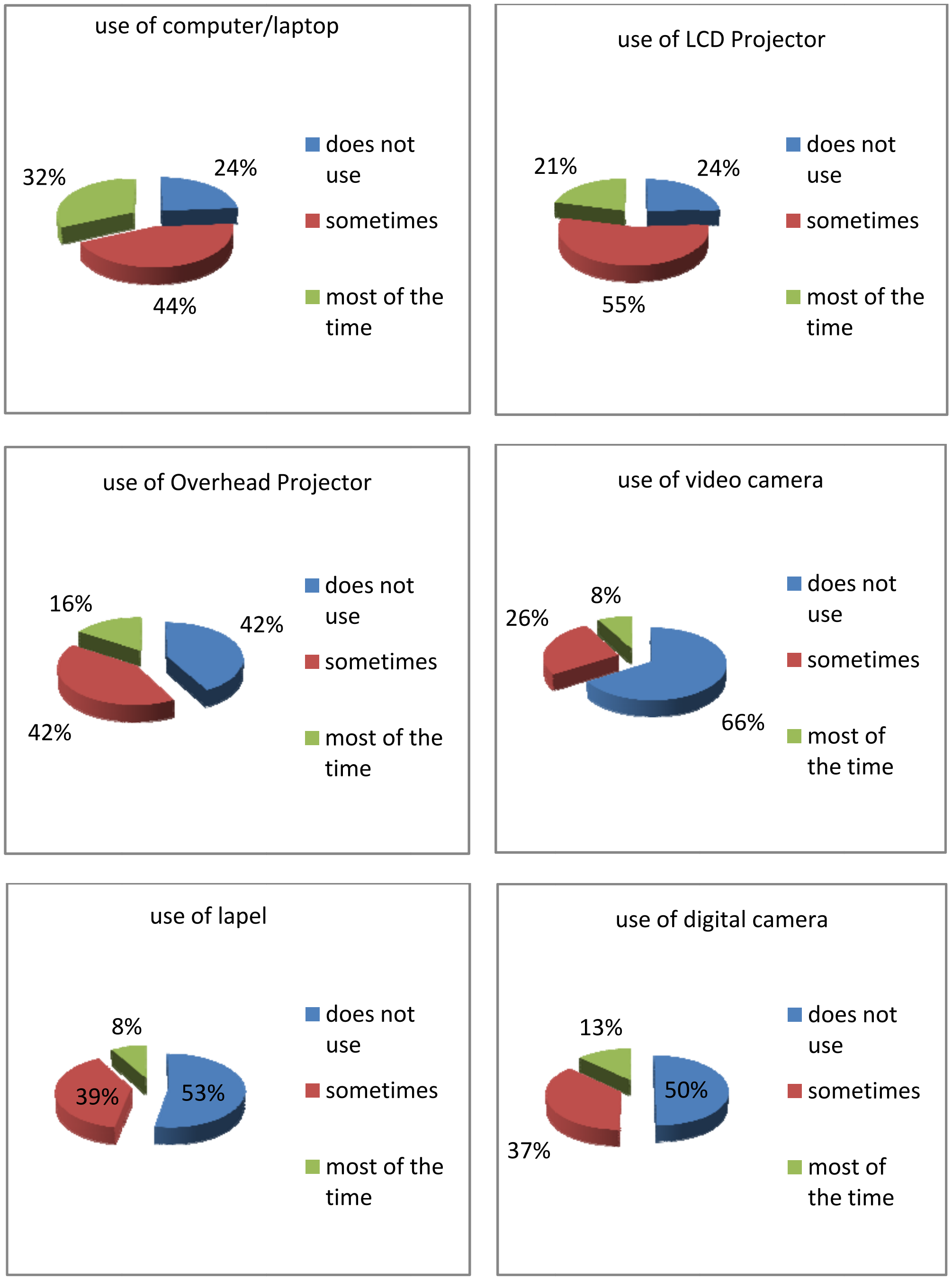

Figure 2: Teachers' Readiness in Terms of Use of ICT Facilities

ICT facilities like the computer/ laptop, LCD projector, video & digital camera and the public address system are very necessary in instruction to enhance teaching and learning. Figure 2 shows that the computer/laptop, LCD projector and OHP are used only sometimes while the video camera, the public address system and the digital camera are not used by the teachers with 66%,53% and 50 % each respectively. This implies that we cannot expect a very high quality learning from our students because according to an article on Computing in Education, Vienna , Austria,(February 22-24,2010) without using the computers and access to the net our students cannot bridge the digital divide and it will be hard to transform education to better suit the needs of networked societies.

An interview with the Budget Officer was conducted regarding the yearly release of budget for ICT facilities needed. Accordingly, all requests for ICT facilities are submitted to the Bids and Awards committee (BAC) and are approved if necessary. The dean informed the researchers no budget comes from non-government agencies rather the funding for ICT Education is totally dependent upon the institution's budget. In sustainability, the monetary aspect is not what that matters alone but it's the totality of the process, functions, and productivity of ICT Education in the future as emphasized by Madden & Weibrod (2008).

The Research and Development Center of the institution has records on file of undergraduate theses which are ICT-related studies. Some are web-based systems or programs and others are computerized or automated programs. It was noted that out of forty-four (44) ICT-related studies, twenty three (23) are for office use, nine (9) for instructional use and twelve (12) are for office use outside of the college like the Engineering, Local Government Unit (LGU) and Philippine National Police (PNP) offices in Polangui, Albay. From this documentary analysis it shows that ICT-related researches if well implemented and used could help boost the capability and sustainability of ICT Education in the institution.

ICT Facilities	Weighted Mean (x)	Descriptive Interpretation	Rank
The college has standard size of ICT laboratory.	4.5	Highly Capable	2.5
It has sufficient number of computers.	3.9	Capable	4
Provides sufficient number of ICT lecture rooms.	3.2	Moderately Capable	5
ICT rooms and laboratory are well-ventilated (air-conditioned).	4.6	Highly Capable	1
It has sufficient furniture and fixtures.	4.5	Highly Capable	2.5
Average Weighted Mean	4.1	Moderately Capable	

Table 1-Level of Capability of ICT Facilities in ICT Education.

Table 1 reveals the results of the assessment made by the respondents on ICT facilities. The fourth variable whether the ICT rooms and laboratory are well-ventilated (air-conditioned) makes it highly capable with a weighted mean of 4.5 and ranked first among other variables. Other indicators like the standard size of laboratory rooms and availability of furniture and fixtures have a weighted mean of 4.6 and 4.5 respectively which makes these highly capable. Although the provision of sufficient ICT room which ranks last is still moderately capable with a weighted mean of 3.9. Generally, the ICT facilities is capable to offer ICT Education. Hence, it calls for the administration to further improve the ICT facilities to fully deliver quality services that would result to quality teaching and learning. This result is not very surprising the fact that Palmer J.(1993) said that the cost of ICT equipment is very expensive and the lack of space limit most Filipino public school to computer education. She added that computer education is generally available only at Filipino private schools like the Jesuit-operated school at Ateneo University de Manila, Philippines.

Faculty Compliment	Weighted Mean	Descriptive Interpretation	Rank
Teaching staff is educationally qualified.	4.2	Capable	3
Faculty have their field of specialization.	5.0	Highly Capable	1
Teachers' posses expertise in information technology.	3.9	Capable	5
Always observe best practices along computer technology.	4.0	Capable	4
Always exercise professionalism in the delivery of services.	4.5	Highly Capable	2
Average Weighted Mean	4.3	Highly Capable	

Table 2- Level of Capability of the Faculty Compliment in ICT Education

The assessment of the respondents regarding the faculty compliment is shown in Table 2. Topping the rank was the second indicator which states that "faculty has their own field of specialization in their respective assignments". It has a weighted mean of 5.0 as perceived by the respondents. Following the rank is that "faculty always exercise professionalism in the delivery of services" with a weighted mean of 4.5 and interpreted as highly capable. A weighted mean of 4.2, 4.0 and 3.9 was the rating in favor of the first, fourth and third indicators which says that "the teachings are licensed and educationally qualified","observe best practices along computer technology" and "possess expertise in information technology". Generally, the faculty compliment has an average weighted mean of 4.3 which means that they are highly capable to integrate ICT in their instruction. As Noble (1995) said the success of ICT education will largely depend upon competent teachers who are even more preferable than the most advanced technology.

Conclusions

The findings revealed in this study showed in general that the college under study is on the step toward capability of ICT Education and that all variables such as ICT facilities, teachers' readiness, budgetary allocation, ICT-related researches are positively contributory to sustain ICT Education in the future. Thus, if ICT Education is sustained then the institution has high hopes to produce better informed citizenry, advance the country's economic and social development.

Policy Implication

In as much as this is an institutional and policy research, its result would be a basis in the development of academic and administrative innovations of the college/ university.

Due to the fast growing information and communication technology, future researches can be conducted to determine how the BUPC can adopt and maximize its sustainability in the succeeding years,

References

Noble, K.A.(1995). *The international education quotation.*22 Balmoor, Birmingham, Open University Press.

Palmer, Janet (1993). *Computer education in the Philippines*. http://www…..

Samuel Mann (2009).*Computing for sustainability*.

State of New South Wales.(1999-2010).retrieved from http://www.curriculum support.education.nsus.gow.au/ict/skills/index.html

Steve Hunka(1971)."*The computers as a teacher* ". retrieved from http://ualberta.ca/ALIMNI/faculties/71autumn.html

Snow, W.,Burns,R.,and Griffin,F.(1998). *Teachers become more important through their role changes within new literacies.* D.J.lieu et. al Toward a theory of new literacies (vol.3)pages 743-770.

Wayan Vota (n.d) http://www.edutechdebate.org/ict4e-sustainability/what-is-sus-in-ict-for-education.

WikiEducator(n.d) retrieved from http://wikieducator.org/ "need and importance of information technology in education".

THE TECHNOLOGY, TECHNICAL SKILL, AND R&D CAPABILITIES IN INCREASING TO THE MARKETING PERFORMANCE IN INDONESIA TELECOMMUNICATION SERVICE COMPANIES

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Abstract

In the situation which hyper competitive, companies have to maintain capabilities and achieve competitive advantage to create superior customer value in increase marketing performance. This paper proposes a model through technology, technical skill and R&D capability which are representing the company's core competencies, those can increase marketing performance. The research method used is causal research or verification, the survey was conducted on telecommunication service companies in Indonesia. The method of analysis using path analysis. The finding suggest that the third component core competencies consists of technology, technical skill, and R&D capability influence toward the marketing performance simultaneously.

Keywords: technology; technical skill; r&d capabilities; marketing performance

1. Introduction

Telecommunication development can be seen from the growing of the number telephone subscriptions and the quality of telecommunication services. Increasing the welfare of the community along with the development of telecommunications, it can be shown by several indicators that can be used by policy makers to determine the development strategies associated with telecommunication nationally and regionally. The convergence of technologies make telecommunication network not only voice stream but also various types of data including internet access and television broadcasting.

The majority of telecommunication technology in Indonesia currently is importing. For the overall device through testing in BPPT until July 2009 only 1.4 % derived from domestic, from China 52.7%, US 7.2%, Italy 3.8%, and the remaining from Taiwan, Korea, and others (Ditjen Postel, 2009). This shows dependence of the telecommunication service provider in Indonesia toward the import of telecommunication technology.

Meanwhile the new technology and the continuing new invention of telecommunication technology growth as presented by the Gilder's Law (Tangia, 2003) that findings of telecommunication technology broadband allowed bandwidth increase its capacity to double every 9 months as illustrated in figure 1.

Fig. 1 ICT Technology Progress, ICT Issues and Opportunities

Telecommunications company is a high-technology companies that involving the use of high technology and require the high ability (technical skill) for the core competencies which source for the company to achieved the competitive advantage.

Core competencies are collective sets of knowledge, skills, and technologies that a company applies to add value for its customers (Machado, 1977). Having and maintaining the resources and the core competencies are essence every business which is key to achieve the competitive advantage in the business.

In order to increase competitiveness through technology required research and development activities that integrated with corporate strategy. Roussel, et. al. (1991) explains that in the industry, "R" (research) in the concept of Research and Development should be interpreted as a 'creative', while the "D" (development) is defined as 'practices for commercialization'. Within the scope of strategic management, management of research and development work to integrate technology with business strategy, then perform the operational management of research and development, so the results can be applied to all functions of the organization, where every function of the organization can work together in accordance to achieve corporate goals.

Marketing performance is a measure successful of marketing strategy that will be detected by track customer satisfaction, retention, and perceptions on value. Then the success or failure will be observed in financial performance in the form of gains in revenue, total contribution, net profit, and cash flow.

Based on the described above, this paper proposed solution for telecommunication service companies can survive related back to basic is to improve the company's core competence which is a source of competitive advantage that can increasing marketing performance.

2. Literature Review

Core competence is a distinctive capability company and sources of maintain sustainable in business. An organization's core competence could be in a technology, a product, a process, or the way it integrates its technological assets. Core competence may also be the human knowledge or skill of an organization's employees (Khalil, 2000). Core competence must be a skill or capability of a firm. A core competence is central to a firm's value-generating activities (Mooney, 2007).

The fortunes of high-technology firms depend on investments in intellectual capital – R&D capability, human capital, and the like – has been well established, the central role of complementary marketing capital – in the form of brand name and other marketing assets (Rao, 2005).

This paper based on framework that core competence is distinctive resources consist of technology, technical skill and capability R&D (Chumaidiyah, 2011), as shown at figure 2.

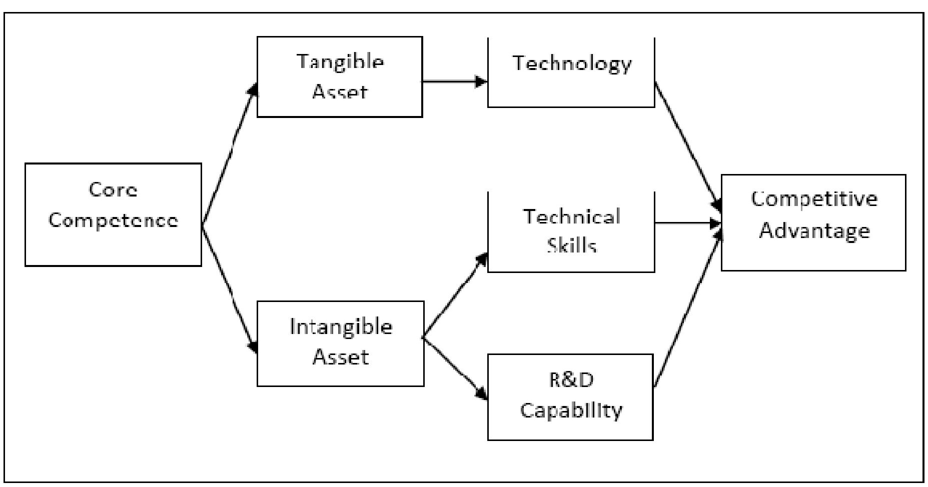


Fig. 5 Technology, Technical skill and Capability R&D to Competitive Advantage

The key success factor competitive advantage company is created through its own capability that representing core competence. Core competence consist of technology that representing tangible asset, while technical skill and R&D capability representing intangible asset.

Andersen (2011) suggested some specific aspects of the relationship between strategic resources with company's performance has been studied as Resources Based Theory (RBT). Relationship between distinctive capability with performance have been described in the literature and have been studied in a variety of perspectives such as resources-based, organizational learning theories, knowledge-based, and dynamic capabilities perspectives (De Carolis, 2003). And marketing performance is part of the company's performance.

3. Method

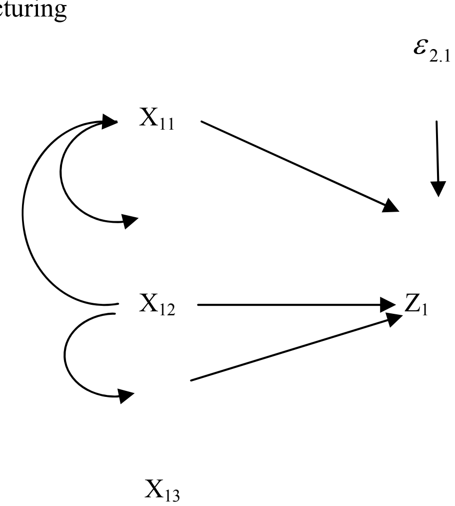
This study is causal/verification research because intend to determine the relationship between the variables research in causal relationship so that there are independent variables and the dependent variable.

The unit of analysis is telecommunication service companies that describes the technology, technical skill, R&D capability and marketing performance. Base on the time horizon is cross sectional. Sources of data from primary data obtained through survey directly on the telecom services companies by using questionnaires with measurement ordinal scale. The test statistic used is the Path Analysis, with sample study by 84 companies.

Path Analysis is the statistical technique used to examine causal relationships between two or more variables. A measured variable is a variable that can be observed directly and is measurable. Measured variables are also known as observed variables, indicators or manifest variables. Path analysis deals only with measured variables. The amount of the relationship of an independent variables to dependent variables called path coefficients (P_{yx}).

Hypothesis : technology, technical skill, and R&D capability influences to marketing performance simultaneously and partially. The testing as follows :

1) Structuring



X_{11} : technology

X_{12} : technical skill

X_{13} : R&D capability

Z_1 : marketing performance

Fig. 7 Path Structure

2) Calculate the equation

$$Z_1 = P_{Z_1X_{11}} X_{11} + P_{Z_1X_{12}} X_{1.2} + P_{Z_1X_{13}} X_{1.3} + \varepsilon_1 \quad (1)$$

3) The decision of acceptance or rejection of H_0
   a) Operational hypothesis formulation

$H_0 : P_{Z_1X_{1i}} = P_{Z_1X_{1j}}$

$Hi : P_{Z_1X_{1i}} \neq P_{Z_1X_{1j}}$; $i \neq j$

b) Decision criteria
Reject H_0 if $t_{account} \geq t_{(0,05)(n-k-1)}$

Accept H_0 if $t_{account} < t_{(0,05)(n-k-1)}$

Where
$$t = \frac{P_{Z_1X_{1i}} - P_{Z_1X_{1j}}}{\sqrt{\frac{(1-R^2{}_{Z_1(X_{11}X_{12}X_{13})})(C_i + C_j + 2C_{ij})}{(n-k-1)}}}$$

7.

4. Result

In the result calculation by Lisrel 8.7 path diagram between the three variable of technology, technical skill, and R&D capability to marketing performance, such as the path coefficients obtained in the following table.

Table 1. Path Coefficient Technology, Technical Skill, dan R&D Capability to Marketing Performance

Variable	**Path Coefficient**	T_{count}	
$X_{1.1}$	0,3064	3,0805	
$X_{1.2}$	0,4186	4,1682	$R^2 = 0,5301$
$X_{1.3}$	0,1467	1,7426	

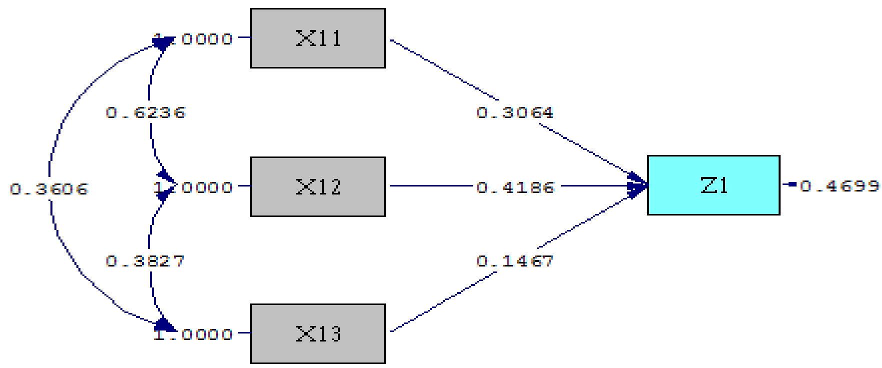
For the overall core competencies contribute to influence to marketing performance at 53,01% (R^2Value) in telecommunication service companies. Among the three variables of core competencies, technical skills (X_{12}) provide the most influence to marketing performance, follower by technology (X_{11}), and the latest R&D capability (X_{13}).

Diagram of the structural equation between the three variables of core competencies to marketing performance in the telecom service companies described as follows.

Z1 = 0.3064*X11 + 0.4186*X12 + 0.1467*X13, Errorvar.= 0.4699, R^2 = 0.5301 ...... (2)

(0.09947) (0.1004) (0.08417) (0.07431)

3.0805 4.1682 1.7426 6.3246



X_{11} : technology

X_{12} : technical skills

X_{13} : R&D capability

Z_1 : marketing performance

Fig. 8 : Path Diagram Technology, Technical Skills, and R&D Capability to Marketing Performance

1) Overall Testing

H_0 : All $\rho Z_1X_{1i} = 0$ i = 1,2	Technology, technical skills and R&D capability simultaneously do not influence to marketing performance.
H_a : There $\rho Z_1X_{1i} \neq 0$ i = 1,2	Technology, technical skills, and R&D capability simultaneously influence to marketing performance.

The hypothesis testing through the F test statistic to reject H_0 if the F_{count} is greater than F_{table}, or otherwise to accept H_0 if F_{count} less than or equal to F_{table}. Through the value of coefficient of determinant (R^2 value) in table 1 can be calculated the value of F by the following formula.

$$F_{count} = \frac{(n-k-1)R^2_{Z_1(X_{11}X_{12}X_{13})}}{k(1-R^2_{Z_1(X_{11}X_{12}X_{13})})} \quad \ldots\ldots. (3)$$

$$F_{count} = \frac{(84\text{-}3\text{-}1) \text{ x } 0{,}5301}{3(1\text{- } 0{,}5301)}$$

$$F_{count} = 30{,}083$$

From table F for significance level of 0.05 and degrees of freedom (3,80) obtained F_{table} values of 2,719. Because F_{count} (30,083) is greater than F_{table} (2,719) then with the error rate 5% it was decided to reject H_0 and accepted H_a. So with confidence level 95% can be concluded that the variables of technology, technical skills, and R&D capability simultaneously influences to marketing performance significantly in telecommunication services company.

2) Partially testing : the influence technology to marketing performance

$H_0 : \rho Z_1X_{1i} = 0$ Technology partially does not influences to marketing performance

$H_1 : \rho Z_1X_{1i} \neq 0$ Technology partially influences to marketing performance

Based on the processing results in table 1 can be seen the value of the variable t_{count} technology to marketing performance by 3,0805. While from table t with error rate 5% and degrees of freedom 80 obtained values T_{table} of 1,990. Because of the variable T_{count} technology (3,0805) is greater than T_{table} (1,990), then with error rate 5% it was decided to reject H_0 and accepted H_a. So with confidence level 95% can be concluded that the technology influence to the marketing performance partially and significantly in telecommunication service companies. With increasing sophisticated in technology will be improving to the marketing performance in telecommunication services companies.

The influence of technology to the marketing performance consist of :

- The direct effect of technology to marketing performance = $(P_{Z_i X_{1i}})^2 =$ (0,3064) × (0,3064) = 0,0939 (9,40%)
- The indirect effect of technology to marketing performance because of its relationship with the technical skills = $P_{Z_1 X_{11}} \times r_{X_{11} X_{12}} \times P_{Z_1 X_{12}}$ = (0,3064) x (0,6236) x (0,4186) = 0.080 (8%).
- Indirect effect of technology to profitability because of its relationship with R&D capability = $P_{Z_1 X_{11}} \times r_{X_{11} X_{13}} \times P_{Z_1 X_{13}}$ = (0,3064) x (0,3606) x (0.1467) = 0,016 (1,6%)

So the total influence of technology to the marketing performance on telecommunication services companies = 9,4% + 8% + 1,6% = 19% with a positive direction, meaning that 19% change on marketing performance can be explained by technology in the telecommunication services companies.

3) Partially testing : the influence technical skill to marketing performance

$H_0 : \rho Z_1X_{12} = 0$ Technical skills partially does not influences to marketing performance

$H_1 : \rho Z_1X_{12} \neq 0$ Technical skills partially influences to marketing performance

Based on the processing results in table 1 can be seen the value of the variable t_{count} technical skill to marketing performance by 4,1682. While from table t with error rate 5% and degrees of freedom 80 obtained values T_{table} of 1,990. Because of the variable T_{count} technical skill (4,1682) is greater than T_{table} (1,990), then with error rate 5% it was decided to reject H_0 and accepted H_a. So with confidence level 95% can be concluded that the technical skill influence to the marketing performance partially and significantly in telecommunication services companies. With increasingly sophisticated in technical skill that will improve to the marketing performance in telecommunication services companies.

The influence of technical skills to the marketing performance consist of :

- The direct effect of technical skills to marketing performance = $(P_{Z_1 X_{12}})^2 =$ (0,4186) × (0,4186) = 0,1752 (17,52%)

- The indirect effect of technical skills to marketing performance because of its relationship with the technology = $P_{Z_1X_{11}} \times r_{X_{11}X_{12}} \times P_{Z_1X_{12}}$ = (0,3064) x (0,6236) x (0,4186) = 0.080 (8%).
- The indirect effect of technical skills to marketing performance because of its relationship with R&D capability = $P_{Z_1X_{12}} \times r_{X_{12}X_{13}} \times P_{Z_1X_{13}}$ = (0,4186) x (0,3827) x (0.1467) = 0,0235 (2,36%)

So the total influence of technical skills to the marketing performance on telecommunication services companies = 17,52% + 8% + 2,36% = 27,88% with a positive direction, meaning that 27,87% change on marketing performance can be explained by technical skills in the telecommunication services companies.

4) Partially testing : the influence R&D capability to marketing performance
$H_0 : \rho Z_1X_{13} = 0$ R&D capability partially does not influences to marketing performance
$H_1 : \rho Z_1X_{13} \neq 0$ R&D capability partially influences to marketing performance

Based on the processing results in table 1 can be seen the value of the variable t_{count} R&D capability to marketing performance by 1,7426. While from table t with error rate 5% and degrees of freedom 80 obtained values T_{table} 1,990. Because of the variable T_{count} R&D capability (1,7426) is lower than T_{table} (1,990), then with error rate 5% it was decided to accepted H_0 and rejected H_a. So with confidence level 95% can be concluded that the R&D capability partially does not influence to the marketing performance significantly in telecommunication services companies. It is because of the influence of R&D capability to marketing performance very low at 6,13%.

The influence of R&D capability to the marketing performance, consist of :

- The direct effect of R&D capability to marketing performance = $(P_{Z_1X_{13}})^2$ = (0,1467) × (0,1467) = 0,0215 (2,15%)
- The indirect effect of R&D capability to marketing performance because of its relationship with the technology = $P_{Z_1X_{13}} \times r_{X_{11}X_{13}} \times P_{Z_1X_{11}}$ = (0,1467) x (0,3606) x (0,3064) = 0.0163 (1,63%).
- The indirect effect of R&D capability to marketing performance because of its relationship with technical skills = $P_{Z_1X_{12}} \times r_{X_{12}X_{13}} \times P_{Z_1X_{13}}$ = (0,4186) x (0,3827) x (0.1467) = 0,0235 (2,35%)

So the total influence of R&D capability to the marketing performance on telecom services companies = 2,15% + 1,63% + 2,35% = 6,13% with a positive direction, meaning that 6,13% change on marketing performance can be explained by R&D capability, but because of very low, it does not influence to marketing performance significantly as evidenced on the above.

The finally, influence of core competencies to marketing performance about 53,01% both from technology (19%), technical skills (27,88%), and the last R&D capability (6,13%). There is an error 46,99% appreciable can be predicted from external factors that do not accommodated in the model structure. Because core competencies is just internal resources or internal factors of the firm. The external factors coming from marketing aspect and another factors like customer, competitor, vendors, etc

Technical skills and technology more dominant in improving the marketing performance than R&D capability. This is because of R&D capability currently at the lowest categories that have not been able to support company to create product or services which superior customer value. In fact the technology, technical skill and R&D capability are sources in create a high performance product differentiation that provides chance to increase customer satisfaction.

Although the contribution of R&D capability to marketing performance is very low at 6,13%, but through the activities of R&D can be created services which superior customer value. R&D capability have not been able to generate superior product or service that directly impact on marketing performance in the telecommunication services companies. It is therefore important for company to increase R&D capability so it can be balanced with company's technical skills and technology, those are core competencies of the companies.

Furthermore the low of R&D capabilities on telecommunication services company show on the low empowerment of domestic telecommunication technology as seen from the very limited local content. Therefore to enhance the empowerment of domestic telecommunication technology necessary effort to increase R&D capability, this takes place the role from policy makers.

5. Conclusion

Core competence is distinctive resources consist of technology, technical skills, and R&D capability. The third variable : technology, technical skills and R&D capability influence to the marketing performance significantly and simultaneously. Technical skills the most variable influence to marketing performance, thus follower by the technology, those are two variables (technology and technical skills) influence to the marketing performance either partially or simultaneously. While R&D capability not influence to the marketing performance partially. It means that R&D capability on the Indonesia telecommunication services company currently very weak and cannot support company to create product or service which superior customer value that can increase customer satisfaction. So, very important for company to improve the R&D capability that can support to increase marketing performance.

For empowering domestic telecommunication technology necessary effort to increase R&D capability in telecommunication services companies, this requires support from the government as policy-makers. It is expected to encourage increased local content in business telecommunication services in Indonesia

Finally, there are another factors not including on the model structure expressed error model, from external factors like marketing aspect, customer, competitor, etc. For future research direction, this model structure have to including another factor as described before which can increase R^2 value and reduce error model.

References

Ditjen Postel. (2009). "Buku Statistik Bidang Pos dan Telekomunikasi Tahun 2009, Semester II", http :// www.postel.go.id.

Ditjen Postel. (2010) "Buku Statistik Bidang Pos dan Telekomunikasi Tahun 2010, Semester I", http :// www.postel.go.id.

Tangia, R. (2003). *"ICT Issues and Opportunities*", School of Computer Science.

Machado, F.M. (1997). *Technology Management for Leap-Frogging Industrial Development: The Challenge for Developing Countries at the Beginning of the New Millenium*, UNIDO, Vienna.

Roussel P. A., Saad K. N., and Erickson T. J. (1991). *Third Generation R&D – Managing the Link to Corporate Strategy*. Harvard Business Scholl Press.

Khalil, T. (2000). *Management of Technology: The Key to Competitiveness and Wealth Creation*, McGraw-Hill Book Co., Singapore.

Mooney, A. (2007). Core Competence, Distinctive Competence, and Competitive Advantage: What Is the Difference?, *Journal of Education for Business*, *November/December*, 110-115. From: http://heldref@ebsco.com.

Rao, R.K.S. and Bharadwaj, N. (2008). Marketing initiatives, expected cash flow, and shareholders' wealth. *Journal of Marketing, 72*, 16-26.

Chumaidiyah, E. (2010). The Conceptual Design of Competitive Advantage For Telecommunication Services Business In Indonesia Through Core Competence Approach. *Proceedings International Conference on Telecommunication (ICTel)*. IT Telkom, Bandung, Indonesia.

Chumaidiyah, E. (2010). Kajian pemikiran tentang pengaruh teknologi, kemampuan teknik dan kegiatan R&D terhadap keunggulan kompetitif pada industri berbasis teknologi tinggi, "*Proceedings of Ritektra*. Fakultas Teknik Unika Atma Jaya. Jakarta, Indonesia.

Chumaidiyah, E. (2010). Theoretical Framework : The Influence of Technology, Technical Skill and Research & Development Capability To Competitive Advantage. *Proceedings The International Conference on Industrial Engineering And Business Management (ICIEBM)*, UIN – Sunan Kalijaga, Yogyakarta, Indonesia.

Chumaidiyah, E. (2011). Theoretical Framework : The Influence of Core Technical Competence and Core Marketing Competence to Competitive Advantage. *Proceedings The 2nd International Conference on Industrial Engineering And Operations Management (IEOM)*. Kuala Lumpur, Malaysia.

Chumaidiyah, E. (2010). Kompetensi Inti dan Strategi Bauran Pemasaran dalam Meningkatkan Keunggulan Bersaing Pada Perusahaan Jasa Telekomunikasi. *Jurnal Telekomunikasi*. Terakreditasi Nasional - Dikti. Edisi Desember 2010. Volume 15 no. 2.

Andersen, J. (2011). Strategic resource and firm performance. *Management Decision*. Vol. 49 No. 1, pp. 87-88.

De Carolis, D.M. (2003). Competencies and imitability in the pharmaceutical industry: an analysis of their relationship with firm performance. *Journal of Management, 29*, 27-50.

STRENGTHENING A RESEARCH COOPERATION USING A TRIPLE HELIX MODEL: CASE STUDY OF POULTRY INDUSTRY IN THAILAND

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Abstract
The Triple Helix Model has a main focus on interactions between three parties to reaching the same goal by their aptitudes. This paper demonstrates the collaboration among government sectors or intermediary organization, industry and university applying the Triple Helix Model to enhance effectiveness of the research cooperation for poultry industry. The poultry sector has been widely acknowledged as one of the greatest agro-business success story in Thailand. It has been selected as a case study to show the success of Triple Helix strategy for agro-business and technology development in Thailand. The research cooperation is developed form the industrial needs meanwhile knowledge and technology are developed and applied specially to solve those needs. These mechanisms are investigated and discussed in present paper. The role of intermediary organization is very important to link and match the needs and technologies of industries by creating knowledge network, facilitating knowledge transfer and sharing. Moreover, the intermediary organization is able to link industry to financial support agencies. Strong commitment and effort of the team from all parties are the key to achieve a successful sustainable development of technology.

Keywords: intermediary; research cooperation; technology development; poultry industry

TRIPLE HELIX CONCEPT IN DISASTER MANAGEMENT USING STRATEGIC ENVIRONMENTAL ASSESSMENT: CASE STUDY OF GOVERNMENT OFFICE RELOCATION PLANNING OF PADANG CITY, INDONESIA

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Abstract

Disaster management is the dynamic form of series of integrated and sustainable activities that is carried out before, during and post disaster in order to realize the optimum protection to the community, social assets, economy and environment (Rachmat, 2004). National and local governments play a key role in it, especially in the disaster risk reduction by establishing the policies, plans and programs. Universities and research institutions supports the effort by providing expertise in the tools and methodology as well as providing education and training for the government's personals. Businesses, in form of private consultancies, get involved in the project level by processing and analyzing the data using the appropriate methods.

Strategic and environmental assessment is the keywords in Strategic Environmental Assessment (SEA). Strategic means that it happens in an early enough stage in the decision making process that it can have a significant influence on key decisions. Environmental is considered in the broadest sense which means that besides natural or bio-physical impacts, it may also include related social and economic aspects (Looien, 2009).

This paper would like to present how SEA is utilized in the spatial planning decision for relocating Padang City Government office to a free hazard area while considering the socio-economic environment. The methodology used in this work is a case study of site selection for relocation of Padang City Government office and look at the interaction of government, academics and business in the process. It is followed by the discussion on the triple helix model that applies, including the cooperation and mutual relationship with international bodies in terms of exchange of hardware and software equipment with relevant data. The paper will result in the conceptual triple helix model that applies in disaster management. As a case study, the result of the work has its limitation but provide insight about the innovation in building infrastructure in hazard prone areas.

Keywords: Disaster Management, Strategic Environmental Assessment, Building Infrastructure

"GOVERNMENT SUPPORT IN TRIPLE HELIX COLLABORATION TO PROVIDE HEALTH SERVICE DELIVERY: CASE STUDY GOVERNMENT HOSPITAL IN BENGKULU HOSPITAL"

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Abstract
Quality improvement in public service has become a major concern in government institutions as an effort to provide the optimum public service, include for government hospitals in Bengkulu Province. The objective of this study is analyzing the quality level of the service provided by three government hospitals namely RSUD M Yunus, RS Jitra, and RS. DKT (Dinas Kesehatan Tentara). The study uses quantitative-positivistic approach with sampling techniques performed by non probability sample through accidental sampling. This study uses analysis of the Service Quality (SerQual) and the Importance-Performance Analysis (IPA). Results showed the dimension of the highest service priority level based on the ratings given by respondents is the assurance. While at the lowest priority of service quality is different, there are differences in all three hospitals. The result shows that health service delivery in Bengkulu involves three stakeholders, which is manifest from triple helix collaboration in providing health service delivery. The stakeholders are academician from Universitas Indonesia who conducts the research; PT Askes (Persero) as Public enterprise who deliver profit oriented body by delivering health insurance, and government by government hospital (RSUD M Yunus, RS Jitra, and RS DKT). Continued research in this area is needed to determine the readiness of Indonesia in implementing the national social security system in health to be held in January 2014.

Keyword: Government Hospital, Importance-performance analysis, Public service, Service Quality, Triple Helix Collaboration

SOCIO-ECONOMIC FACTORS AFFECTING TO IMPLEMENTATION OF BUSINESS MANAGEMENT AND PRIMATANI TECHNOLOGY AND NET INCOME OF BANANA AGRIBUSINESS (A Case Study of a Project of *Primatani* in Cugenang Subdistrict, Cianjur, Indonesia)

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Abstract

The research purpose is to know the effect of socio-economic factors of farmers who do banana agribusiness on the implementation of business management and *primatani* technology, and net income of banana agribusiness. The results of research concluded that socio-economic factors of farmers who do banana agribusiness effect on the implementation of business management and *primatani* technology. The implementation of business management and *primatani* technology positive significant effect on net income of banana agribusiness. The *primatani* should be developed at farmers have land area above 1.284 hectare, at productive farmers, and farmers could act as selling price maker.

Keywords: socio-economic factors, agribusiness, bananas, primatani, net income

1. Introduction

Bananas are traded widely and, in terms of gross value of production, are the world's fourth most important crop after rice, wheat and maize. Between 1988 and 1998, annual world exports of bananas almost doubled to 12 million tonnes. The banana companies are largely associated with Latin America, a region which accounts for over 83 per cent of world exports. Bananas from this region are known as 'dollar bananas'. Ecuador dominates world markets, exporting over 4 million tonnes per annum. The country's comparative advantage stems from favourable natural and social conditions: an abundance of fertile land with sufficient water; few disease problems; cheap labour; and reduced exposure to tropical storms (Hellin, et al, 2002).

Indonesia is one of many countries banana producing, although the number is still limited. Ecuador and the Philippines is a major competitor countries of banana exports to several countries. Banana export destination for Indonesia include Saudi Arabia and some European countries. Many types of bananas are grown in Indonesia is Capendish bananas. Banana cultivation in Indonesia is mostly done in West Java, Yogyakarta and East Java.

The banana may be the world's oldest cultivated crop. Human beings in Southeast Asia began to select and cultivate wild Musa varieties as many as 10,000 years ago. It may have taken a few thousand years for those early agriculturists, acting in tandem with nature's genetic dice, to produce sterile hybrids like the Cavendish and other sweet varieties still cultivated today. Incapable of reproducing sexually, these seedless wonders propagate vegetatively, by suckering. During the first or second millennium B.C., Arab traders carried banana suckers with them from Southeast Asia to the east coast of Africa (Canine, 2005).

Banana in Indonesia is one of the leading agricultural commodities. Most of the banana agribusiness committed by smallholder agriculture which is still traditional management. Currently, demand of bananas for domestics and exports can not be met by existing production. Therefore, it is still an open chance to increase production through the addition of the harvested area, improvement of business management and application of agricultural technologies.

Given the banana as an export commodity that is reliable, then the development of the cultivation of bananas received special attention. The agribusiness of banana in lots of areas developed as a unit of industrial agribusiness which is based on business management and agricultural technology. The central government through the Ministry of Agriculture is pleased to apply business management and technology continuously to banana agribusiness more profitable.

The primary concern is less about coming up with a definition of a fair banana that we can all agree upon and more about building alliances between farmers, workers, consumers and activist NGOs (Striffler S, 2010). Some 90% of the world's harvest of bananas are grown on small farms in developing countries and much of this crop is eaten by people who live locally (Annonymous, 2005). Resulting from efforts to devolve natural resources are increases in natural resource and land conflicts. Policymakers, therefore, need to be aware of the process of intensification and socioeconomic differentiation that exist in rural communities in Burkina Faso before attempting to intervene in ways that attempt to alter existing natural resource management systems (Gray LC, 2005).

Indonesia concerns *Primatani*. *Primatani* (*Program Rintisan dan Akselerasi Pemasyarakatan Inovasi Teknologi Pertanian*) is the pilot program and acceleration of innovation sosialization of agricultural technology. *Primatani* aims to build the system and agribusiness which are based on knowledge and innovative technology. The system and agribusiness are constructed in such a way so as the supply chain integrated called unit of industrial agribusiness (UAI). UAI is a quasi-organization of all business units in a vertical supply chain in a region (Annonymous, 2006). Its main characteristic is the unity of action so that the final product of supply chain can be managed in full compliance with consumer preferences at the final products are marketed.

Primatani has implemented since 2005 in some selected areas. One area of development is a Cianjur Regency. Cianjur Regency is one of the banana production center that supplies Bandung, Jakarta and the other areas. This is considering the strategic location of Cianjur is near to Jakarta and has the potential of land and agro-climate that allows for the development of good quality of bananas. The banana production centers in Cianjur Regency are Cugenang, Sukaresmi, Parungkondang and Cikalong Kulon Subdistrict.

Given the banana is a commodity and provide revenue that could improve the welfare of farmers in Cianjur, it has been implemented "*Getapis* (*Gerakan Tanam Pisang* or Bananas Planting Movement)". The development of bananas received support from relevant institutions like the Directorate General of Research and Development of Agricultural, the Research and Development Centre of Agricultural and the Application of Agricultural Technology Agency (BPTP). The form of their support is Talaga Village in Subdistrict of Cugenang is used as the location of *primatani*. Through activities of *primatani*, the banana farmers obtain assistance of management and technology and the institutional strengthening of farming.

In the second five-years program period (2011 to 2016) needs to be formulated a model of *primatani* more appropriate and effective manner. It needs to know the socio-economic situation of farmers community who do agribusiness of banana. The independent researches to evaluate the implementation of *primatani* on several socio-economic factors of farmer's at the first five-years period (2005 to 2010) are not exist. Therefore, it is necessary to do research on the influence of socio-economic factors that occurred on the implementation of *primatani*, as materials of evaluation and development of *primatani* in the next period.

2. Thinking Framework

The application of technology is a process or series of activities the use of technology by users. Applying the technology is to make technology as part of the operation of the functions of technology, technology makes it known, accessible, and functioned in an environment that requires. In implementing, developing and disseminating technologies, previously necessary to assess the feasibility study. It evaluates of the technical feasibility, economic feasibility, social, cultural and environmental feasibility and standardization of the technology (Irawan B, 2005).

Drajat B. and Mat Syukur (2006), detailing the performance or the success of technology is measured by four factors that are benchmarks for evaluating the technology. These factors are :

- Technical feasibility. Technology should result in added value, has a feature or diverse capabilities to meet the diverse needs, efficient in use of resources including energy, long-lasting, and other technical factors.
- Economic factors. Technology should result economic productivity or financial profit. One way to evaluate the productivity of the technology is to calculate the ratio of output compared to input. Technologies that do not make profit, called non-pervorming, is not performing. Non-pervorming technologies are usually not sustainable, not sustainable development.
- Third factor, the technology should be acceptable to the users. Technology can be accepted as necessary and beneficial to the user, liked, easy to use, can be purchased at affordable prices, and not against the culture and habits of the user community.
- The fourth factor, the technology must be in harmony with the environment, these factors will determine the sustainability of technology in the community of users.

When *primatani* has not been introduced, the information of management, technology, markets, capitals and support institution for agribusiness of banana were difficult obtained. All of them were obtained from an agricultural extension field (PPL) only, but they were not complete. Now, in the presence of *primatani*, it can grow and develop of an information through the use of agriclinics and direct contact with the researchers from the research halls or other sources, with facilitation by Application of Agricultural Technology Agency (BPTP).

However, farmers' welfare is a complex measure. It can not be viewed only from one aspect only. However, the welfare of farmers does not mean it is difficult to quantify. Farm production and income of farmers is a variable that can be used to measure the welfare of farmers. Because the farm production and the income which is high, farmers can control the factors of production and the facility of life.

Production factors should be used optimally to produce the product. Therefore, each factor must be used with the amount, timing and proper way for resulting in efficient production processes, and maximize revenues. Production factors in agriculture consists of three groups, namely:

a. Physical factors, such as the level of fertility of land, labor, capital, and the means of production (seeds, fertilizers, diseases and pest poisons of plants).
b. Psychological factors, such as entrepreneurial spirit and motivation.
c. Socioeconomic factors, such as large of land, age, business experience, education level, family dependents, business financing, and determining the selling price.

Primatani is the program that provides an innovation of management and technology to farmers to help banana farmers in increasing their income and production. In the conduct of these innovations are the problems faced by farmers. This is expected the role of technological innovation of *primatani* to solve the problems faced by farmers.

Schhematically, thinking framework can be seen in Figure 1.

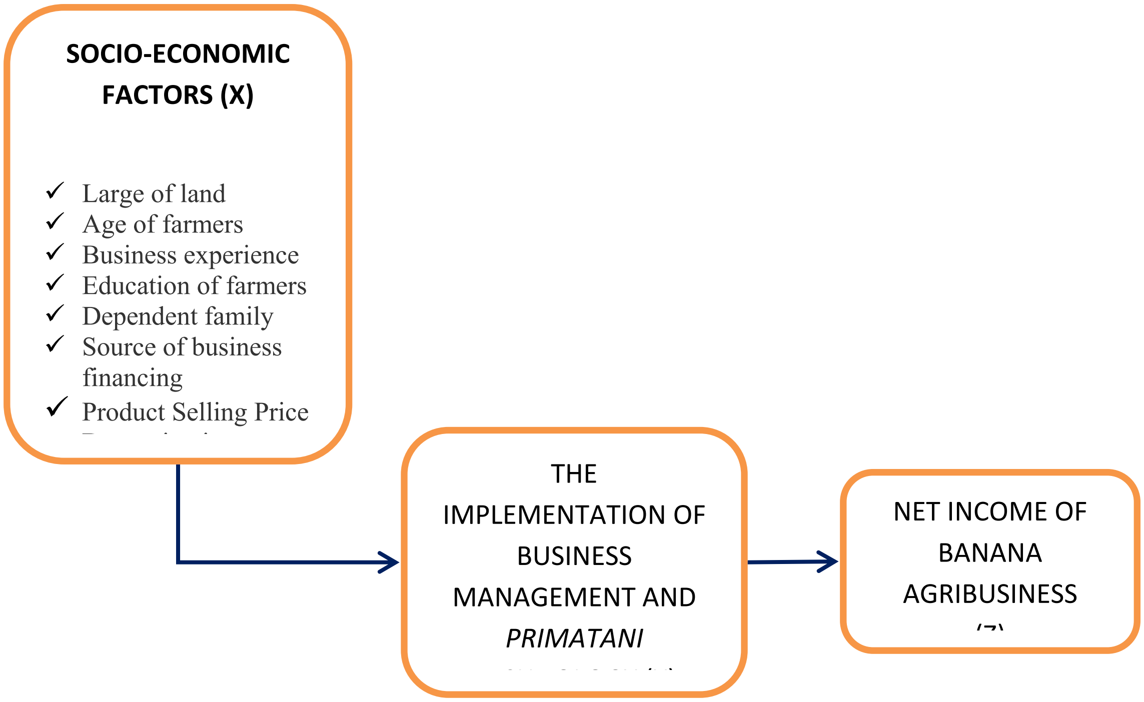

Fig. 1. Scheme of thinking framework

Based on the above description, the problem of this research can be formulated as follows:

- How does the influence of socio-economic factors of farmers of banana agribusiness simultaneously on the application of business management and primatani technology ?
- How does the influence of socio-economic factors of farmers of banana agribusiness partially to the application of business management and primatani technology ?
- How does the application of business management and primatani technology effect on net income of banana agribusiness ?

3. Research Method

Research objects are socio-economic factors of banana farmers, implementation of business management and *primatani* technology, and net income of banana agribusiness. The method used is survey method. The survey is a sample survey of farmers who seek of banana agribusiness. Farmers who become respondents are the farmers who own and do to process of banana agribusiness, and they take to apply of business management and technology of *primatani* in Talaga Village, Cugenang Subdistrict, Cianjur, Indonesia.

Target population is the farmers of banana agribusiness who are built by *primatani*. Target population 133 people. The sample size was randomly assigned by simple random sampling. The size of sample farmers are 44 people of the banana farmers.

The first hypothesis: "Socio-economic factors of farmers of banana agribusiness influence to the application of business management and technology of *primatani*". The first hypothesis testing use the method of multiple linear regression model (Gujarati, 2003), namely :

$$Y = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_7 X_{7i} + \delta_i \quad (1)$$

Description:

Y = The application of business management and *primatani* technology
X_1 = Large of land
X_2 = Age of farmers
X_3 = Experience of business

X_4 = Education of farmers
X_5 = Dependent family
X_6 = Source of business financing
X_7 = Product Selling Price Determination
δi = Error

The second hypothesis: "The application of business management and technology of *primatani* effect on net income of banana agribusiness ". The second hypothesis testing use test of different two averages between before and after the *primatani* applied.

4. Analysis and Interpretation

4.1. The First Hypothesis

The first hypothesis states that "Socio-economic factors of farmers of banana agribusiness affect to the application of business management and *primatani* technology". Based on the result of data analysis are obtained the coefficient of elasticity the application of business management and *primatani* technology for each dimention of socio- economic factors. There are shown in Table 1.

Table 1. The partial analysis of socio-economic factor affecting the application of business management and *primatani technology*

Variable	Coefficients	Standard Error	T Stat	P-Value
Intercept	3.453	5.098	0.677	0.503
X_1 (Large of Land)	1.289	0.431	2.990	0.005
X_2 (Age of Farmer)	-0.576	0.578	-0.995	0.326
X_3 (Business Experience)	0.212	0.383	0.553	0.584
X_4 (Farmers Education)	0.728	0.340	2.143	0.039
X_5 (Dependent Family of Farmers)	0.426	0.506	0.842	0.405
X_6 (Sources of Business Financing)	0.944	0.866	1.090	0.283
X_7 (Determination of Product Selling Price)	-0.618	0.875	-0.707	0.484

Based on the data in Table 1, the model of multiple linear regression show highly significant indicated by the F count = 13.526 is much larger than F table = 4.88. Therefore the model can be used to predict or forecasting the state of the banana agribusiness. The relationship between socio-economic factors (X) with the application of business management and *primatani* technology is shown from the number of regression coefficients (R) = 0.851 which includes strong relationship.

Further figures are obtained the coefficient of determination (R^2) = 0.725, which means 72.5 % of variability on the application of business management and *primatani* technology on banana agribusiness can be explained by the dimensions : large of land, age of farmers, business experience, farmers education, dependent family of farmers, source of business financing, and determination of products selling price, and the remaining 2.5 % is explained by other variables outside the model. These circumstances explain that the influence of large of land, age of farmers, business experience, farmers education, dependent family of farmers, source of business financing, and determination of product selling price, simultaneously determine the level of implementation of business management and *primatani* technology.

Based on the results of regression analysis where the model function use the power function are obtained the model functions as follows :

$$Y = 3{,}453\ X_1^{\ 1{,}289} X_2^{\ -0{,}576}\ X_3^{\ 0{,}212} X_4^{\ 0{,}728}\ X_5^{\ 0{,}426}\ X_6^{\ 0{,}944} X_7^{\ -0{,}618} \tag{2}$$

The power function model has several advantages such as the power of each socio-economic factors (independent variables) that affect the application of business management and *primatani* technology (Y) is the coefficient of elasticity of the production (ε_{xi}). These show the changes in these factors result in changes against the application of business management and *primatani* technology.

Large of land (X_1) is a significant on the degree of error (α) = 5 %. Coefficient of elasticity value (ε_{x1}) = 1.289 (elastic positive), meaning that each additional one percent large of land or one percent of optimization of land use will improve the application of business management and *primatani* technology of 1.289 percent.

Different events for age of farmers (X_2) in the banana agribusiness. The results of the statistical tests, age of banana farmers are not significant effect of the application of business management and *primatani* technology. Age of farmers who make banana agribusiness has a negative elasticity coefficient (ε_{x2}) = - 0.576 (inelastic negative), meaning that each additional year of one percent of farmers age will reduce the application of business management and *primatani* technology of 0.576 percent.

Business experience (X_3) is not significant to the application of business management and *primatani* technology. Elasticity coefficient value (ε_{x3})= 0.212 (elastic positive), meaning that each additional one percent of business experience will enhance the application of business management and *primatani* technology of 0.212 percent.

Farmers education (X_4) is significant effect on the application of business management and *primatani* technology. Elasticity coefficient value (ε_{x4})= 0.728 (elastic positive), meaning that each additional the level of farmers education by one percent would increase the application of business management and *primatani* technology of 0.728 percent.

Dependent family of farmers (X_5) is significant effect on the application of business management and *primatani* technology. Elasticity coefficient value (ε_{x5}) = 0.426 (elastic positive), meaning that each additional in the number of dependents family of farmers of one percent will increase the application of business management and *primatani* technology of 0.426 percent.

Source of business financing (X_6) is significant effect on the application of business management and *primatani* technology. Elasticity coefficient value (ε_{x6}) = 0.944 (elastic positive), meaning that each additional source of financing of the dominance of external funds (loans) of one percent will increase the application of business management and *primatani* technology of 0.944 percent.

Determination of selling price (X_7) is not significant effect of the application of business management and *primatani* technology. The elasticity coefficient value (ε_{x7}) = - 0.618 (inelastic negative), meaning that each additional in the dominance of determining the selling price by the purchaser of one percent will reduce the application of business management and *primatani* technology of 0.618 percent.

The coefficients of the application of business management and *primatani* technology on all dimensions of socio-economic factors, it looks a contribution of inputs is high. The situation is understandable considering the application of business management and *primatani* technology in banana agribusiness have been scouted extensively by the *primatani*.

4.2. The Second Hypothesis

The second hypothesis states that "The application of business management and *primatani* technology effect on net income of banana agribusiness". Hypothesis testing based on analysis of different test pairs on average. Based on the analysis showed that t_{count} obtained is much larger than t_{table}. It is significant effect in the error rate (α) = 5%. Therefore, It may be concluded that the application of business management and *primatani* technology significantly affect on net income of banana agribusiness. This means that with the higher level of business management and *primatani* technology, then it will increase the net income of banana agribusiness. And vice versa.

5. Conclusions and Recommendations

5.1. Conclusions

Based on the results of research and the testing of empirical data can be deduced as follows :

- The application of business management and *primatani* technology simultaneously influenced by socio-economic factors of farmers of banana agribusiness, include : large of land, age of farmers, business experience, farmers education, dependents family of farmers, source of business financing, and determination of product selling price.
- Socio-economic factors consisting of large of land, age of farmers, business experience, farmers education, dependent family of farmers, source of business financing, and determination of product selling price, that they are together can be used as a model to predict changes on the application of business management and *primatani* technology primatani, with influence the change of 72.51%.
- Partially, socio-economic factors significantly affect positively on the application of business management and *primatani* technology are large of land, business experience, farmers education, dependent family of farmers, and source of business financing. All five have a positive production elasticity and elastic. So that any increase in each input causes increasing the implementation levels of business management and *primatani* technology in banana agribusiness.
- Partially, socio-economic factors significantly affect negatively on the implementation of business management and *primatani* technology are age of farmers and determination of product selling price. Both have a negative production elasticity and inelastic. So that any increase in each input causes decreasing levels of business management and *primatani* technology in banana agribusiness.
- Socio-economic factors that namely large of land has the most elastic of production elasticity than other socio-economic factors.
- The application of business management and *primatani* technology significantly affect on net income of banana agribusiness.

5.2. Recommendations

- Age of farmers and determination of product selling price significantly affect negatively and they have an inelastic. Therefore, the *primatani* development should be carried out on a group of farmers, namely the young and productive age, and on a group of farmers to be able to determine selling price of product itself. Agricultural institutions in *Primatani* should have the power to banana farmers to enter a perfectly competitive market together to compete with the buyers / consumers in global markets. Consequently, important to continue to increase knowledge and application of business management, as well as continue to make continuous improvements in the application of agricultural technology in *primatani*.
- Given large of land gives a positive significant effect and it is elastic, the *primatani* model should also be developed on a group of farmers who own the large of land over at the average area for banana agribusiness. Unfortunately, the research did not get to find the minimum square footage of an efficient banana agribusiness. The research is based only on the average size of land holdings as a minimum size for banana agribusiness, and this value would be very different between planting regions and varieties of plants, depending on the weather and land conditions. For the direction of future research also needs to know the minimum area of land for an efficient banana agribusiness.
- Reception technological innovations by farmers often stop at some point. This is due to saturation of the farmers and their inability to face the current situation it faces. Therefore, another important aspect of the *primatani* program is that should pay attention to the regeneration of farmers and organizational restructuring of agriculture on an ongoing basis.
- Optimal size of each socio-economic factors that give optimal effect on net income of banana agribusiness need to be defined more clearly and definitely. Therefore more further research are needed more in-depth.

References

Amborse, Gavin & Harris, Paul. *The Visual Dictionary of Graphic Design*. London ; 2006.

Annonymous. Science and Technology : Going Bananas Agriculture. *The Economist* 2005 : Volume 377, Oct 22.

Annonymous. *Basic Design of Primatani*. Research and Development Agency of Agriculture, Ministry of Agriculture ; Republic of Indonesia, 2006.

Boyd, Walker, and Larreche. *Manajemen Pemasaran*. Jakarta : Erlangga ; 2000.

Cangara H. *Pengantar Ilmu Komunikasi*. Jakarta : Raja Grafindo Persada ; 2002.

Canine C. Building a Better Banana. *JS Sci : Comprehensive Works* 2005 : Volume 36, Oct 2005 : 96 – 104.

Drajat B. and Mat Syukur. *Institutional Technical Instructions. TOT Material Appreciation and Management Concepts for Managers of Agribusiness Laboratory*. Center for Technology Assessment and Development of Agriculture : Research and Development Agency of Agriculture, Ministry of Agriculture; Republic of Indonesia, 2006.

Gray LC. What Kind of Intensification? Agricultural Practice, Soil Fertility and Socioeconomic Differentiation in Rural Burkina Faso. *The Geographical Journal* 2005 : Volume 171, March 2005 : 70-82.

Gujarati, DN. *Basic Econometrics*. Fourth Edition. New York : Mc-GrawHill ; 2003.

Hellin J, Higman, Sophie. Smallholder Banana Producers Need Policy Adjustments. *Journal Agricultural Economics* 2002 : Volume 28, Jun 2002 : 65 – 66.

Irawan B. *Technical Guidelines for Base Line Survey of Primatani*. Research and Development Agency of Agriculture, Ministry of Agriculture , Republic of Indonesia, 2005.

Lionberger H. and Gwin P.H. *Communication Strategies : a Guide for Agricultural Change Agents*, Canville : The Interstate Printers & Publisher Inc. ; 1982.

Rogers EM. *Diffusion of Innovations*. Fiveth Edition. New York : The Free Press.; 2003.

Senjawati ND, Sri W, Sunaru SH. Prospects of Farming Development Through the P4K Program In Bantul Regency.. *Jurnal Agrosains* 2001 : Volume 14 September 2001 : 3.

Soekartawi. *Prinsip Ekonomi Pertanian*. Jakarta : Rajawali Press ; 2003.

Striffler S. Fair Bananas: Farmers, Workers, and Consumers Strive to Change an Industry. *Journal of Latin American Studies* 2010 : Volume 42, May 2010 : 438 – 439.

GOVERNANCE OF SUSTAINABLE PALM OIL IN INDONESIA

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Abstract
Using earth system governance as analytical framework, this study explores the governance of the palm oil in Indonesia and the interactions between policy instruments at global, national and sub national level. This study shows that the coexistence of policy making at multiple levels has the potential of both conflicts and synergies among different levels of regulatory activities. There is a mutual dependence between stakeholders to achieve sustainable palm oil production by creating alliances and it is demonstrated that by pursuing innovations in technology, new business models and policy support, the problems which hinder sustainability of palm oil production could be reduced.

Keywords: green growth; palm oil; REDD+; policy instruments; innovation; governance.

1. Introduction

The history of the Indonesian palm oil industry started in 1911 with the establishment of commercial oil palm plantations in the Northern Sumatera region [1]. The plantations evolved slowly up to the mid-1970s, after which growth became rapid due to governmental support. One of the support schemes was the introduction of nucleus estates in which the big companies take the role of a nucleus, not only to promote itself but also to develop estates belonging to small holders. Since 2006, Indonesia surpassed Malaysia as the number one palm oil producer in the world. In 2010, according to Indonesia's Central Statistical Agency [2] Indonesia palm oil industry produced 22 million tons of crude palm oil (CPO) compared to Malaysia with 17 million tons of CPO. Palm oil knows many applications in the food industry (e.g.: margarine, emulsifier, cooking oil, shortening, ice cream) and non-food industry (e.g.: lubricants, cosmetics, pharmaceuticals, etc.). The socio-economic effect is that palm oil plantations created 4.5 million jobs with an export value of 15 billion US$. However, the expansion of palm oil production has brought along some negative environmental impacts such as deforestation, biodiversity loss and peat land destruction [3]. Huge deforestation in Indonesia between 1997 and 2007 has been caused by the expansion of palm oil production. It is reported that the haze in Southeast Asia during that period was caused by land clearing through burning away the tropical forest to create space for oil palm plantations. Another impact of deforestation is the loss of the natural habitats for Sumatran tigers, Sumatran rhinoceros, Asian elephants and Borneo's orangutans. When their natural habitats are destroyed, these animals are unable to survive and have now become endangered. The third impact is the destruction of peat land; 12% of Indonesia's land area is peat land. It is reported that more than 60,000 fires in Indonesia since 1997 happened in peat land areas [3]. In this study, we analyzed the palm oil governance in Indonesia using Earth System Governance's framework followed by the current development in palm oil production. Then the governance of this palm oil was elaborated with the given framework followed by the conclusion.

2. Earth System Governance Framework

The concept of the Earth System Governance (ESG) by Biermann et al. [4] was introduced by the International Human Dimensions Programme on Global Environmental Change (IHDP) in 2009 as 'the interrelated and increasingly integrated system of formal and informal rules, rule-making systems, and actor-networks at all levels of human society (from local to global) that are set up to steer societies at all levels of human society (from local to global) that are set up to steer societies towards preventing, mitigating, and adapting to global and local environmental change and, in particular, earth system transformation, within the normative context of the sustainable development'. There are five analytical themes in this concept; architecture, agency, adaptiveness, accountability and legitimacy, and allocation and access. There are four themes that cross these themes: power, knowledge, norms and scale.

2.1. Architecture

The architecture theme concerns the interlinkages of the international regime, regime clusters or regime complexes and the broader consequences of regimes. Also, at national and local levels, there are interlinkages between the political integration into national/ local law which has times overlap. The concept of governance architecture enables an analysis of situations in which a governance area is regulated by more than one institution. This concept utilizes the overarching systems of public and private institutions, principles, norms, regulations, decision making procedures and organizations that related with this area. This architecture can be described as meta-level governance. This meta level governance is not understood as static entity, but rather as a fluid, dynamic process that continuously evolves according to pressures and governance processes.

2.2. Agency

The agency theme concerns the role of institutions at local and global level. This theme often cuts across public and private level. At international level, actors span the entire spectrum from public non-state such as government bureaucracies or city governments to public-private such as environmentalist alliances or scientific networks, to purely private actors such as business associations and indigenous people networks. There is reconfiguration of authority in the realm of governance which tries to distinguish between actors and agents in this theme. Actors refer to the individuals, organizations, and networks that participate in decision making related to the earth system governance. An agent (authoritative actor) is an actor who possesses the ability to prescribe behavior and to obtain the consent of the governed. Authority refers to legitimacy and capacity to exercise power, while power refers to the capacity to influence an outcome of events, with or without the legitimacy to do so.

2.3. Adaptiveness

The adaptiveness theme is associated with vulnerability, resilience, adaptation, robustness, adaptive capacity or social learning and describes changes made by social groups in response to or anticipation of challenges set by environmental change. In the ESG framework, adaptiveness includes the governance of adaptation to socio-ecological change as well as the process of change and adaptation within governance systems. How societal response and adapt with the governance systems is important particular with under the situation when relative weak policy and legal instrument to protect the people‘s interest.

2.4. Accountability and legitimacy

In the 20th century, the legitimacy and accountability were problems of national governance, but in the 21st century they appear in a different context. In the international setting, the legitimacy of international organization is derived from their principals, the governments, - which are accountable to their voters. In the domestic setting, the private organizations may derive legitimacy through their members or donors, or from the environmental goods they seek to protect. There is a huge need to develop and design institutions that guarantee participation of civil society through mechanisms that grant a balance of opinions and perspectives.

2.5. Allocation and access

'Who gets what, when, where and how' is a key questions in political systems. This theme focuses on the allocation of the benefits and risks and access to the benefits. Fair allocation and distribution is important within governance to avoid the unequal allocation of local and global levels since this inequality could cause vulnerability to the global environmental change.

3. Palm Oil Development in Indonesia

According to World Bank [5], 75% of the world's poor live in rural areas and most of them are farmers. To meet the Millennium Development Goals (MDG) of halving poverty by 2015, 14 billion US$ are required annually in developing countries. The World Bank already committed to invest up to 8.3 billion US$ in 2012; however, it needs an innovative approach in pursuing public-private partnerships, which generate investment, reduce poverty and deliver growth. Rising food demand due to increasing population size and climate change are placing additional pressures on rural livelihood and the environment. Palm oil which is produced from the fruit of the African oil palm (*Elaeis guineensis*) has become one of the most important oil crops and has multiple applications both as food and as non-food. The oil palm is cultivated in tropical countries with humid tropics and has become an important basis for local economies, as raw material for local industry and food for local consumers. Palm oil has become the driver for economic growth in Southeast Asia, Central and Western Africa and to some extent in Latin America [6]. The palm oil industry plays a significant role in generating income and reducing poverty in producing countries.

In Indonesia, palm oil has become one of the most important commodities besides oil and gas sector. It contributes to exports with 19.4 billion US$ in 2011 which equals 12% of total export for non-oil and gas products and 9.7% of the total national export [7]. With a total population of 237 million people in 2011, the production of palm oil also provided 4.5 million jobs from upstream, intermediary and downstream processes. In 2011, in the total export of palm oil: 54% are derived from upstream products (crude palm oil, crude palm kernel oil), 5% from intermediary products (crude palm, kernel olein and stearin) and 41% from downstream products (refined bleached deodorized palm olefin (cooking oil) and refined bleached deodorized palm and kernel oil, and stearin). The production of Biodiesel made from palm oil increased; 2009 (200,000 tone), 2010 (255,000 tonnes) and 2011 (500,000 tonnes). The statistical data on palm oil production in 2010 [2] show that palm oil production produced on 8.1 million hectares of land. The land belonged for 52%, 40% and 8% to the private industry, smallholders and the state respectively.

Agriculture contributes 15.34% to the Indonesian GDP in 2010, the second largest contribution after industry. This agriculture sector proved itself resilient and reliable to help the recovery from the Asian Financial Crisis in 1998. Since 2006, Indonesia is the largest palm oil producer in the world with a market share of 47.5%. In terms of jobs; 38% of the palm oil plantations are was owned by smallholders, 54% by private industries and the rest by the state. While palm oil production has a positive impact on employment and income, it is often criticized as a major contributor to deforestation and greenhouse gases (GHG) emissions. The deforestation in Indonesia was mostly caused by changes in the land use from forest into palm oil plantation. The problem has arisen by the governance framework, while strong economies incentives given by this palm oil but weak capacity to guiding the development of the plantations onto areas where the environmental impact is minimized. The sustainability of palm oil production has become a major concern for the buyers and is important in trading. Europe, the USA and other countries require a certificate before the supplier countries can sell their palm oil. Such certification is also required by companies, such as several major food companies like Nestle and Unilever, which use palm oil as raw materials. This is important to ensure the sustainability of their entire production process and part of the companies' responsibility to their customers. In Indonesia, the social and environment impact of-palm oil production has become a main concern due to changes in land use and weak governance.

4. Sustainable Palm Oil Governance

This section will elaborate upon how the governance systems of sustainable palm oil production in Indonesia are based on the five themes of the ESG framework: architecture, agency, adaptiveness, accountability and legitimacy, allocation and access.

4.1. Architecture

The palm oil industry grew exponentially over the last 30 years and proved itself as one of the success stories in economic development and poverty alleviation. The World Bank itself has been active in the palm oil sector since 1970s, initially in Indonesia and later also in West Africa and Central America [6]. Palm oil offers significant opportunities for economic growth, employment and poverty reduction, but it can also have significant adverse environmental and social consequences. There is a compelling need for concerted multi-stakeholder action to strengthen the impacts on development, mitigate negative consequences and build sustainability across the sector. The key reason for this vast growing in palm oil production is the competitive advantage of this crop. Palm oil is over five times more productive in production per hectare compares to other vegetable oil crops. Also, this crop has the lowest requirement for fuel, fertilizers and pesticides per ton of production. This crop has multiple functions; in food and non-food uses, ranging from cooking oil, pharmaceutical products and as feedstock for biofuel.

Further, in response to the urgent and pressing global call for sustainably produced palm oil, the Roundtable on Sustainable Palm Oil (RSPO) was formed in 2004 with the objective to promote the growth and use of sustainable oil palm products through credible global standards and engagement of stakeholders [7]. RSPO is a not-for-profit association to develop and implement global standards for sustainable palm oil production that unites stakeholders from seven sectors of the palm oil industry - oil palm producers, palm oil processors or traders, consumer goods manufacturers, retailers, banks and investors, environmental or nature conservation non-governmental organizations (NGOs) and social or developmental NGOs.

Table 1. Differences between RSPO and ISPO [8]

RSPO	ISPO
Principle 1: Commitment to transparency	
Principle 2: Follow the law and the rules	Principle 1: Legislation and plantation management
Principle 3: Commitment to economy and financial welfare in long term	
Principle 4: Best practice for plantation and plant	Principle 2: Applied technical guidance for cultivation and processing palm oil
Principle 5: Environment responsibility, natural resources conservation and biodiversity richness	Principle 3: Environment management and monitoring
Principle 6: Responsibility to employee, individual, and community affected by plantation and plant activities.	Principle 4: Responsibility to the worker
	Principle 5: Social and community responsibility
	Principle 6: Community economy empowerment

Principle 7: Responsibility development to the new plantation	
Principle 8: Commitment to the sustainable maintenance to the core activities	Principle 7: Sustainable business development

To create a sustainable production, the government, by its Ministry of Agriculture, developed the Indonesian Sustainable Palm Oil (ISPO) in addition to the established RSPO [7]. While RSPO is voluntary scheme, ISPO is an obligatory scheme which requires that all palm oil estates and palm oil related industries should comply with national and international accreditation standards. This scheme also must comply with international organizations related to trade (WTO) and climate change (UNFCCC). In 2011, the Ministry of Agriculture enacted a decree on the establishment of Indonesia Sustainable Palm Oil (ISPO) which requires all palm oil estates and palm oil related industry to adopt sustainable practices by 2014. The main objectives in establishing the ISPO are:

1. To develop palm oil production as an integral part of Indonesian economic development.
2. To support Indonesia efforts to fulfill the international demand for sustainable palm oil.
3. To support Indonesia commitment to sustainable natural resources and environmental functions.

Thus ISPO is compulsory for all plantations in Indonesia and RSPO is voluntary to attain international recognition. Implementation of certification was January 2012 and the ISPO will be fully implemented in 2014. Table 1. shows the difference between RSPO and ISPO. Both schemes pay attention to the use of best practice for plantation and the processing. Further, ISPO addresses environment protection, conservation of natural resources and prevention of biodiversity loss as well. To cope with the growing demand of palm oil domestically and internationally, the policy response was to provide innovation in sustainable production, breeding of new superior plants with higher yield and resistance to the pest.

4.2 Agencies

There are several state and non-state actors in the development of palm oil production in Indonesia. The role of private actors in this sector is large while government acts more as a regulatory body. There are several governance agencies which are in charge of the development palm oil production: the palm oil industry, government institutions, monitoring institutions which monitor the sustainability of the industry, financial institutions for funding, and supporting institutions: labour unions, buyer associations, suppliers and research institutions as shown in Fig 1.. Government institutions play a role as the regulatory bodies and provide the regulations for market mechanisms. Several ministries are in charge with different scope. The Ministry of Trade handles the domestic and international trade. The Ministry of Agriculture works for the plantation regulatory and the Ministry of Industry is in charge of the processing plants (mills). Since land rights are important, particularly for indigenous people and to avoid the conflicts over land ownership among stakeholders, the National Land Agency is the important agency to decide on and register permits for plantations, industries and land ownership.

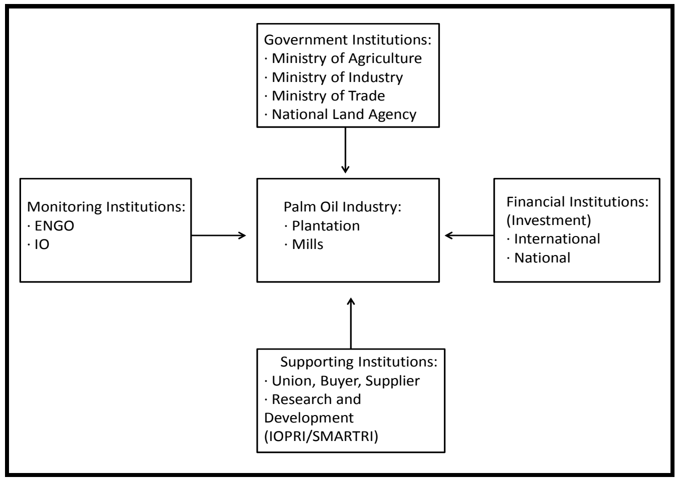

Fig 1. The agencies in Sustainable Palm Oil production

In monitoring institutions, there are two kinds of institutions: environment based NGOs/ ENGO (e.g.: Greenpeace, Sawit Watch) which act as a watch dog on environmental protection, and international organizations (e.g.: UNEP, UNDP, etc) which act as the regulators in global environmental governance. Due to its high rate of deforestation, as Indonesia converts land from forest into palm oil plantation, there is interest, at local, national and international level, into how the palm oil industry can obtained land and ensure sustainable production. Despite the importance of these NGOs as advocates for environmental justice, sometimes they tend to exaggerate. This tends to force the palm oil industry into the defence because they feel under attack by environmentalist and ENGO. This situation is counterproductive because sustainable production can only be achieved with transparency and goodwill. The solution would be a pro-active dialogue among stakeholders: academics, government, NGOs and the palm oil industry.

Financial institutions consist of international and domestic investors. Due to its importance for economic growth, the palm oil industry already is included as a major economic activity in the Master Plan of Acceleration and Expansion of Indonesia Economic Development 2011-2025 [9]. To accelerate the economic development, the palm oil sector requires investment of 92 trillion rupiah (9.68 billion US$ at exchange rate 1 US$~ 9,500 rupiah). Currently, the role of private investment is more important than public funding. International institutions such as World Bank group already invested 50 million US$ (latest data are from 2007) [6]. In supporting institutions, we are focus with the research and development institution. Due to limited availability of land and the restrictions on the expansion of plantations, and to cope with the increasing global demand, there is much interest to boost productivity by innovations in palm oil production. Innovation is being studied at several research institutions, e.g.: the Indonesian Oil Palm Research Institute (IOPRI) and Sinar Mas Research Institute (SMARTRI). In IOPRI, the working unit focuses on: biotechnology, commodity development, socio-economic development, applied technology and international cooperation [1]. SMARTRI has seven working units: agronomy, breeding, crop protection, environment, support services and quality control, laboratories, field operation and extension services [10].

4.3. Adaptiveness

In Indonesia, the annual production of palm oil has been growing significantly from slightly more than 200,000 tons in 1970 to around 21 million tons in 2010 [11]. At the same time, the area used for cultivation has been expanding to 8 million ha by 2009 [12]. A high global market price has made palm oil production a lucrative business. Since the beginning of 1980's, the price has increased significantly from around 400 US$ per metric ton, reached a peak of 1,200 US$/t in 2010 and has remained at around 900-1,000 US$/t in 2012 [13]. The high price promises a high return on investment and attracts more investment, which in turn will trigger consequential conversion of land to palm oil plantations. Several impacts have been reported of the expansion of palm oil plantations on local communities. Not only is deforestation one of the major causes of global warming, it also has significant ecological and economic impacts including loss of biodiversity, hydrological changes due to alterations in the retention of water and rainfall rates, soil erosion and potential loss of GDP [14]. The result is the loss of valued ecosystem services for human populations, particularly poor people who may have limited resources and highly depend on the forest for their livelihood. To the indigenous people, land is life. Several cases show an unjustifiable inconsistency in the law relating the recognition and respect for the native people.

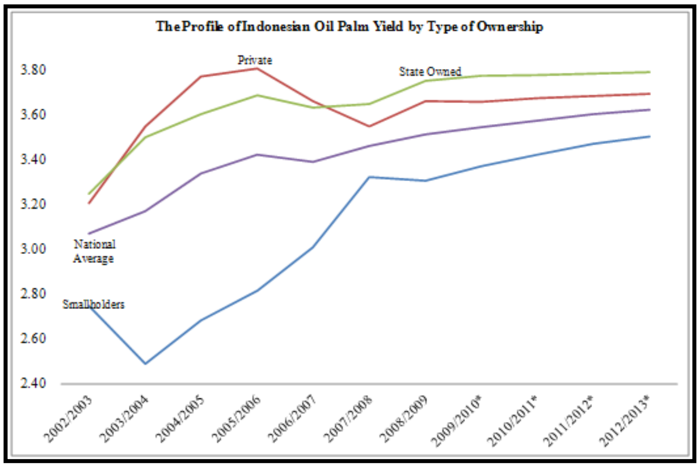

Fig 2. Indonesian Oil Palm Yield by Type of Ownership [15]

Conversion in land use can be minimized by applying sustainable plantation practices including intensified production in existing plantations. Oil palm is by far the most productive plant compared to oil crops as soybean, sunflowerseed and rapeseed, occupying only 4% of the total plantation area for all oil producing plants in the world (2008), while producing 31% of global produced oils and fats [16]. In Indonesia, the average yield of palm oil is 3.7 tonnes/ha. Potentially, with a combination of a conducive climate and biophysical conditions, using new high-yield varieties, by good harvesting practices and good management, oil palms in Indonesia can achieve a yield of up to 6-7 tons/ha [17]. Fig 2. shows the oil palm yield by type of ownership.The smallholders usually have more difficulties in improving their productivity compared to large private and state-owned industries, as they lack the capacity for sustainable production, by inadequate funding to nurture the oil palms, and also by a lack of knowledge information. Generally, lack of capital and access to financing will force smallholders to buy low quality seeds and enable only low maintenance, resulting in low productivity. One solution to achieve palm oil governance that focuses on people, the environment and profits is by forming alliances among stakeholders and identifying parent companies from established and well organized palm oil industries (Nucleus Estate Smallholder/ plama scheme). NES or *Plasma* is a scheme where 20% of the total plantation area is given to the local community surrounding the plantations owned by private or state owned companies. Parent companies will transfer knowledge and provide market access to smallholders, while smallholders still have the freedom to cultivate their part of the land - forming an ideal model of *plasma* collaboration.

4.4. Accountability and legitimacy

In January 2012, the United States banned the import of crude palm oil (CPO) from Indonesia because of the allegedly higher greenhouse gas emission than allowed for by the standard limit on greenhouse gas emission reductions of 20% set by the EPA for biodesel production from palm oil feedstock. The ban was issued based on the unsustainable production system in the previous years. To support and take an active role in solving global environmental problems, climate change and biodiversity loss, the government of Indonesia has provided a legal framework to avoid further deforestation. In May 2011, the President's Instruction No.10 in 2011 on 'The postponement of issuance of new licenses and improving governance of primary natural forest and peatland' was issued. This regulation is the basis for a moratorium on new licenses for land-based activities, including logging, and establishing plantations in primary forest and peat land areas, and is valid for 2 years, 2011 to 2013. Although criticized as insufficient as a response to the huge deforestation problems, the moratorium is praised as a good stepping stone to improve forest governance. The moratorium would have a positive environmental impact as long as it will focus on the protection of peat land as a critical ecosystem that plays a role in conserving carbon, water and biodiversity. Moreover, the moratorium should be seen as a chance to improve productivity and not be blamed for loss in revenue [18].

The umbrella of government policy on climate change is the path-breaking announcement made by the President of Indonesia at the G20 meeting in Pittsburgh in 2009 which voluntarily pledges to reduce GHG emission by 26% in 2020 compared to a business-as-usual scenario, and promises a further 15% reduction if international support is given. REDD+ scheme was introduced under UN framework in 2008 to gives compensation to those who avoid deforestation and forest degradation, implement conservation, sustainable forest management, and enhance carbon stocks (by reforestation/afforestation). REDD+ emphasizes the notions of transparency, equitability, fairness in benefit distribution and recognition of indigeneous people's and local communities' rights. REDD+,-together with agriculture, energy and transport, industry, waste management, etc., - is backbone of the National Action Plan on the reduction of Greenhouse Gas (GHG) emissions. Sub National/ Regional Action Plans are currently under development based on the National Action Plan.

As a response to their concern with the sustainability of palm oil production, private industries already started practising sustainability measures by adopting the Forest Conservation Policy (FCP) [19]. Golden Agri Resources (GAR), for example, has developed a Forest Conservation Policy (FCP) in collaboration with an ENGO: The Forest Trust (TFT); this policy should create long-term sustainable growth for GAR and the palm oil industry. The FCP also aims to ensure that GAR has a no deforestation footprint. The FCP focuses on no development on High Carbon Stock (HCS) forests, High Conservation Value (HCV) forest areas and peat lands, respect for indigenous and local communities and compliance with all relevant laws and National Interpretation of RSPO principles and criteria. This FCP requires participation from other stakeholders. For example, the government plays a critical role particularly in adopting new regulations and enacting relevant legislation to enable the transformation of the palm oil industry (including establishing and implementing a land swap processes). Key players in the Indonesian palm oil industry should address the conservation policy with respect to HCS; and civil society organizations, local and indigenous communities and other stakeholders must be engaged in the process to reform the palm oil industry.

4.5. Allocation and access

As stated before, in 2010, 38% of the palm oil plantations were owned by smallholders, 54% by companies and 8% by the state. The smallholders are those possessing land below 50 hectares. There are two types of smallholders: independent and supported. Independent smallholders are free to sell to any mill and thus may be able to pursue higher prices. In contrast, supported smallholders are tied to the specific mills. Smallholder's productivity is on average relatively lower than plantations. It is reported in 2008 the productivity is 2.52 tons per hectare for smallholders, 3.88 tons/hectares for private plantation and 4.2 tons /hectare for government plantation [6]. To improve productivity requires agronomy, a well functioning supply chain and an enabling environment. Contrary to previous study [12], it was found - based on field observations -that palm oil production has a positive impact on the economic well being of the local community, in particular the smallholders in nucleus estate plasma schemes (NES). In a preliminary study we interviewed several NES farmers in the Riau region. The smallholders stated their economic improvement which e.g. enabled them to invest in their children's education. This is an increase in the quality of life since farmers usually only studied at elementary school level.

The preliminary observations show that most of the smallholders are transmigrants which obtained land from the Suharto regime in the 1980's. At that time - to create jobs and correct the imbalance in population between Java and other islands - a lot of people from Java migrated to other islands. As a compensation, the government allocated land to them to start their live as farmers. This land was usually forest which was converted by the migrants to paddy fields or for the production of other food crops. However, the farmers often encountered problems in selling the harvest while the land was located in remote area. Also, they encountered problems with pigs and elephants as pests. Due to the uncertaintyof the contract between *Plasma* farmers with the parent companies, farmers could be vulnerable for the disadvantage. However, this should not mean that companies always get most of the benefits from the relation with NES. Farmers should be better informed about their rights and obligations as stated in the contract. and these should be well explained to the farmers before they sign the contract. This would result in better transparency, fair treatment and clear communication. Fluctuations in the global market for palm oil are a critical variable that determines profitability. Some farmers gain significant revenue, while others, without safeguards against uncertain prices, suffer from difficulty in settling their debts.

5. Conclusions

While a forest moratorium is the commitment of the central government, industry needs to be pro-active by and fulfil the growing demand through continuous and improved production. This relies on innovation to create production with higher efficient, reduce the energy demand and increase the productivity of palm oil crops. Under international pressure because of sustainability issues of palm oil and considering the positive contribution there is urgent need for a political response; this response should include scientific and technological development in seeds, agricultural practice, harvesting, pest control, legislation to achieve fair social distribution of wealth, legislation and its implementation to reduce destruction of habitat, etc.

New technologies for breeding, new cultivation methods, new production processes and new transportation systems are expected to increase the productivity of the palm oil industry. The political mishaps which tend to hamper palm oil development should be perceived as a driver to move into sustainability production. New business models should be developed which able to diversify market and increase value added of palm oil products and its derivatives. The market development should not only focus on the traditional buyers but also on emerging economies with a highly potential. Respect for communities right to land will avoid conflict of land ownership between smallholders and large companies, another factor that will affect the success of sustainable management. To stimulate the industry’s initiative for sustainable palm oil production, the government should adopt and enact new regulations and relevant legislation to enable the transformation of the palm oil industry to sustainable pathway. The benefits of palm oil production should be distributed equally among stakeholders. To avoid disadvantages for small farmers, a transparent and clear legal contract is needed between the farmers and parent companies in the nucleus estate/plasma scheme.

The Government of Indonesia has already attempted to attain green growth by promoting its sustainable agriculture production), and plays a positive in global environmental affairs by avoiding deforestation and internalising environmental externalities through the REDD+ program. Still, coherence is needed among existing policies to ensure a sustainability pathway for achieving green growth. Local players also need to be strengthened to address the social, economic, and environmental aspects of the transitions to a sustainable production of agricultural produce. Through strengthened institutional cooperation, the Government could address GHG emissions, enhance sustainable agriculture production, secure energy supply, avoid deforestation, and maintain long term economic growth. By successful institutional strengthening, Indonesia can address both themes of the UN 2012 Rio+20 Conference on Sustainable Development [20]: green economy in the context of sustainable development poverty eradication and institutional framework for sustainable development.

Acknowledgements

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References

[1] Indonesian Oil Palm Research Institute, *Annual Report 2008.* Medan: Indonesia Oil Palm Research Institute; 2009.

[2] Indonesia Central Statistics Agency (BPS*). Indonesian Oil Palm Statistics 2010*. Jakarta: Indonesia Central Statistics Agency; 2009.

[3] Tan, K.T., Lee, K.T., Mohammed, A.R., Bhatia, S. Addressing issues and towards sustainable development. *Renewable and Sustainable Energy Reviews* 2009; 2:420-427.

[4] Biermannn, F., Betsill, M. Michele., Gupta, J., Kanie, N., Lebel, L., Liverman, D., Schoreder, H., Siebenhuener, B., Zondervan, R. Earths System Governance: a Research Framework, *International Environment Agreements* 2009; 10: 277-298.

[5] World Bank. *World Development Report 2008: Agriculture for Development.* Washington DC: World Bank; 2008.

[6] World Bank. *The World Bank Group Framework and IFC Strategy for Engagement in the Palm Oil Sector*. Washington DC: World Bank; 2011.

[7] Roundtable of Sustainable Palm Oil (RSPO). http://www.rspo.org/en/ (accessed on May 20th 2012).

[8] Indonesia Association of Palm Oil Industry. http://www.gapki.or.id/ (accessed on June 21st 2012).

[9] Indonesia Coordinating Ministry of Economic Affairs. *Master Plan Acceleration and Expansion of Indonesia Economic Development 2011-2025*, Jakarta: Coordinating Ministry of Economic Affairs; 2011.

[10] Golden Agri Resources LtD. *For a better Future; Sustainability Report 2010*. Singapore: GAR; 2011.

[11] FAOSTAT. FAO Statistics. www.faostat.org (accessed on June 21st 2012).

[12] Rist, L., Feintreinie, L., Levang, P. The livelihood impacts of oil palm: smallholders in Indonesia. *Biodiversity and Conservation* 2010; 19;1009-1024.

[13] Index Mundi www.indexmundi.com (accessed on June 28th 2012).

[14] Marti, S.: *Losing Ground. The human rights impacts of oil palm plantation expansion in. Indonesia.* Bogor: Friends of the Earth, LifeMosaic and Sawit Watch; 2008.

[15] USDA Foreign Agriculture Service*. Indonesia Oilseeds and Products Update 2011*. Washington DC: GAIN Report; 2011.

[16] Basiron, Y.: Palm oil production through sustainable plantations. *European Journal of Lipid Science and Technology* 2007;109: 289-295.

[17] World Growth. *The economic benefit of palm oil to Indonesia.* Arlington: World Growth; 2011.

[18] Murdiyarso, D., Dewi, S., Lawrence, D., and Seymour, F. Indonesia's forest moratorium: a stepping stone to better forest governance? CIFOR Working Paper 2011;76.

[19] Golden Agri Resources LtD. *Collaboration to Conserve Forest*s. Singapore: Golden Agri Resources LtD; 2012.

[20] United Nations. *The Future We Want*. New York: United Nations; 2012.

GM CROPS AND THE END USERS: COMMUNICATING INNOVATION AT GRASSROOTS LEVEL

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Abstract
Triple Helix of government-Industry-University is seen as a key to the socioeconomic development in the knowledge societies and is being adopted and promoted by many countries. The triple helix literature, emphasizes on knowledge creation, exchange and use at research and development level, with very little focus on the role of communication of knowledge to the end user. With the increasing trends towards knowledge capitalization, it has been observed that communication of innovations to the end users is essential to economize the returns of an innovation. Communication of innovation holds a crucial position in an Agriculture Innovation System (AIS) and was traditionally taken care of by the government extension system. Owing to recent trends in the knowledge market, many industry ventures are initiated for information and knowledge services to the end users. The present study is an attempt to understand the regional level interaction among the actors of the triple helix spiral in the case of communication of innovation for Bt cotton (GM crop).

Keywords: Agriculture innovation system; Genetically Modified (GM) crops; Triple helix; Bt-cotton; information and awareness.

Analyzing Government Policies towards Renewable Energy. Case Study : Biodiesel Industries in Indonesia

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Abstract

As an attempt to change the conventional paradigm on providing subsidized-fossil fuel into providing renewable energy, the Government issued Government Regulation about National Energy Policy and targeted 5% of biofuels contribution to total energy demand in 2025. With a very low supply capability of biofuel industry, Indonesia face challanging situation with the contribution target policy. Using System Dynamics approach, the government policies then being tested to find which policy give significant impact and generate initiative strategy for 2025 energy mix biodiesel constribution.

Keywords : Biodiesel, Mix-Mandatory, CPO, CJO, Indonesia

1. Introduction

1.1. Background

The depletion of fossil fules, problems caused by global climate change and growth in energy demand raise interest in renewable energy application [1], including Indonesia. But, the market lack of information, infrastructure, institutions and public acceptance are the challanges of doing business in the development of renewable energy (especially biofuel) in developing countries, can make the introduction of biofuel (especialy biodiesel) will be premature [2] likewise in Indonesia [3].

Since 2005, the Government heeds the biodiesel industry development as an attempt to change their conventional paradigm on providing subsidized-fossil fuel to fulfill the demand. The previous energy policy held solely by Ministry of Energy and Mineral Resources now become intersectoral with the involvement of Directorate General of Water Reseources, Ministry of Agriculture, Ministry of Forestry, Ministry of Marine Affairs and Fisheries, and Ministry of Defense [4].

To support the changing paradigm, The Government issued Government Regulation No.5 of 2006 about National Energy Policy, and targeted 5% of biofuels contribution (equals to 255 million barrel) to total demand of energy in 2025 (equals to 5.1 billion barrel). Its a huge target, considering the supply capability of biofuel industries are still very low (even almost none). Also, formed National Team for Biofuel to made blue-print and road-map of biofuel development. Ministry of Energy and Mineral Resources also issued Ministerial Regulation no. 32 of 2008 that adding the obligation of biodiesel contribution. The target of biodiesel contribution [5], then will create a market and increase the biodiesel demand [4].

For Indonesia, palm oil is the most suitable vegetable oil to be used for biodiesel industry because of its huge availability. But, palm oil also used for cooking-oil industry with huge market (including export), considering Indonesia as the largest supplier of palm oil in the world. Even so, there is another potential vegetable oil, Jatropha curcas oil, to be used for biodiesel industry but still struggling to reached its economical scale of industry [6].

This changing policies then become a feedback to biodiesel industries from upstream to downstream chain production and dynamically will affecting to the achievement of biodiesel contribution. Therefore, this paper try to analyse the Government policies toward biodiesel industry, combining palm-oil industrial model and jatropha-oil indusrial model using System Dynamics.

1.2. Objectives

This paper aims to (i) identify the state-of-the-art of biodiesel industries in Indonesia, (ii) analyzing the connection of the system structure between crude-palm-oil (CPO) biodiesel production, crude-jatropha-oil (CJO) biodiesel production, fuel consumption, tax, fuel subsidy, mix mandatory, inflation factor and carbon emision, (iii)

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analyze the potential achievement contribution of biodiesel in Indonesia mix-energy 2025, and (iv) generate initiative strategy to fulfull the biodiesel contribution in Indonesia mix-energy 2025

2. Literature Review

2.1. System Dynamics

System Dynamics is a methodology and mathematical modeling technique for framing, understanding and discussing complex issued and problems [7]. It is an approach to understand and analyzing the behavior of complex feedback systems over time and used to design a new policy [8], [9]. It often applies to dynamic problems arising in complex social, managerial, economic or ecological system [10].

As in the biodiesel industry, the increasing demand on biodiesel will give feedback to the biodiesel industry henceforth to the vegetable oil refinery industry and also to the plantation sector to supply the oil. This interactions among element and mostly non-inear and also contain feedback loop can be considered as a complex system [11].

2.2. Biodiesel Industry in Indonesia

Jupesta et.al made a sustainable business model for biofuel industry using SWOT, Porter five force analysis and business analysis to understand the position of biofuel industry in Indonesia [2]. Another approach on analyzing sustainability model for biodiesel industry is using System Dynamics which more specific for Palm Oil model [12]. Silitonga et. analyze the prospect of Jatropha curcas for biodiesel industry [5]. The more comprehensive model, combining biodiesel industry from Palm and Jatropha plant, has been done by Handoko using System Dynamics with several policies being tested to see the achivement of biodiesel contribution on energy mix policy 2025 [4]. However, in Handoko the scenarios was tested using several policies simultaneously. Considering that implementing several polices simultaneously will be challenging, this paper then try to break down which policies is more sensitive to the achivement of biodiesel contribution, analyzing the policies and generate initiative strategy.

3. System Structure

Structure of the modeled system consists of several sectors: (i) plantation, (ii) refinery industry, (iii) biodiesel industry and (iv) market. Plantation sector divided into palm-plantation and jatropha-plantation. Refinery industry sector divided into palm-refinery industry and jatropha-refinery industry. While in biodiesel industry consists of biodiesel from CPO, biodiesel from CJO, and total biodiesel that will be mixed with fossil fuel. In market sector, there are population –a sub-sector that will create demand, tax, selling price, allocation of CPO between biodiesel industry and cooking-oil industry –which depend on selling price, and carbon emission reduction. Since Indonesian market are price sensitive, therefore economy sector is included in each of the sector to measure the profit of each chain.

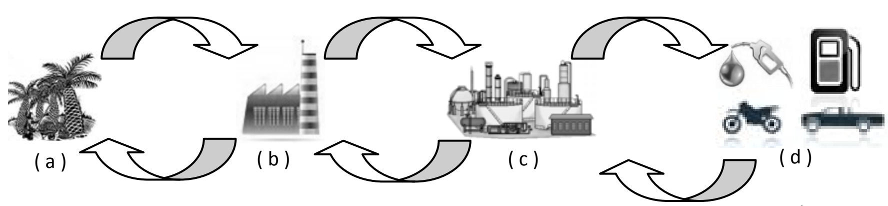


Fig 1. Structures of The Modeled System

3.1. Plantation Sector

In both palm-plantation and jatropha-plantation, the system structure consists of total potential area (to be planted with either palm or jatropha), the existing plantation area, total fruit or fruit bunch being produced from the existing area, and productivity for each tree in the plantation area, see Fig 2a.

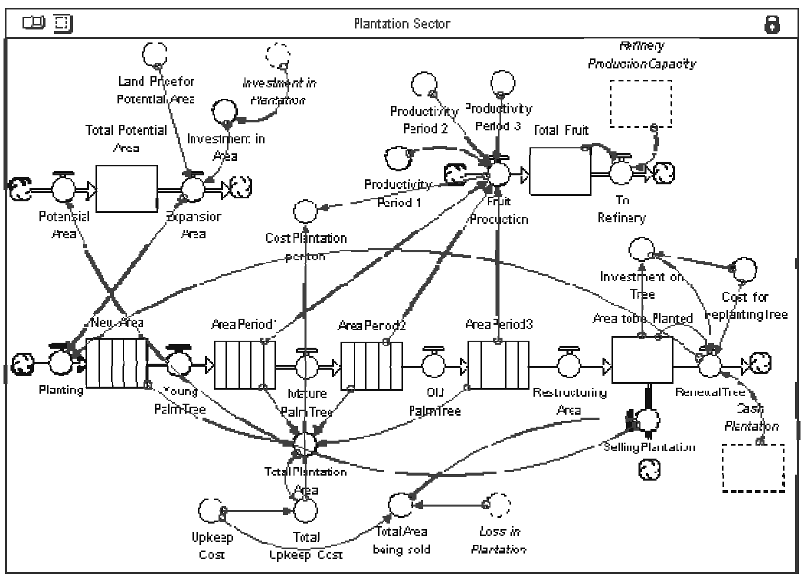
The existing plantation area for both plantations are divided into five categories, (i) area with new tree being plant, (ii) area that consists of young tree (tree aged less than 5-years age for palm, and less than 4-years age for jatropha), (iii) area that consists of mature tree (tree aged 5-22 years for palm, and 4-22 years for jatropha), (iv) area that consists of old tree (tree aged 23-30 years), and (iv) area,with tree aged more than 30-years, that need to be replanting.

These divisions are needed to measure the productivity, since area planted with mature trees is the most productive one. Decision structures in plantation sector are deciding on replanting the unproductive area and/ or expand the area if the cashflow positive, or sell some of the area if the cashflow negative.

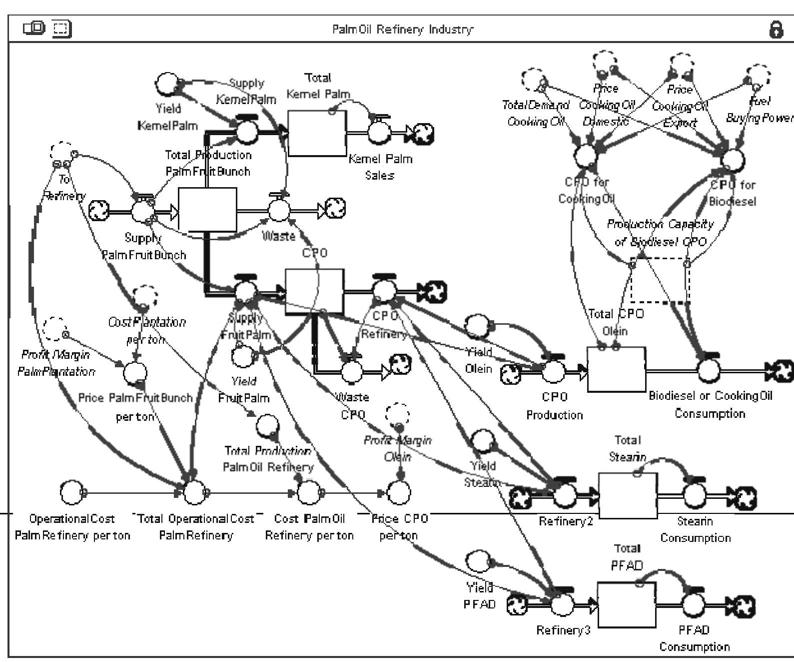
3.2. Refinery Industry Sector

Refinery industry sector for palm feedstock structure is different with jatropha feedstock. Refinery industry for jatropha feedstock only produce crude-jatropha-oil (CJO). While in palm feedstock the refinery process distinguished the palm-fruit-bunch into fruit (*mesocarp*) and kernel. The kernel part produce kernel oil and the fruit (*mesocarp*) produce olein, stearin and palm-fatty-acid-distillate (PFAD), see Fig 2b. Olein mostly used to produce cooking-oil and also for biodiesel, stearin mostly used to produce detergent or washing powder, and PFAD mostly used in food industry as mixture compound for margarine.

Decision structures in refinery industry sector are allocating the CPO for cooking-oil indutry or biodiesel, which industry more attractive buying the CPO, and increase production capacity if the cashflow positive.



(a)



(b)

Fig 2. (a) Stock-Flow Diagram for Plantation Sector; (b) Stock-Flow Diagram for PalmOil Refinery

3.3. Biodiesel Industry Sector

At first, the production of biodiesel from CPO and CJO are seperated. But at the market, both biofuel are mix together with diesel from fossil fuel. Economy sector also included in this structure to support the decision maker to increase biodiesel production capacity if the cashflow positive. Figure 3 is an example of biodiesel industry sector for CPO.

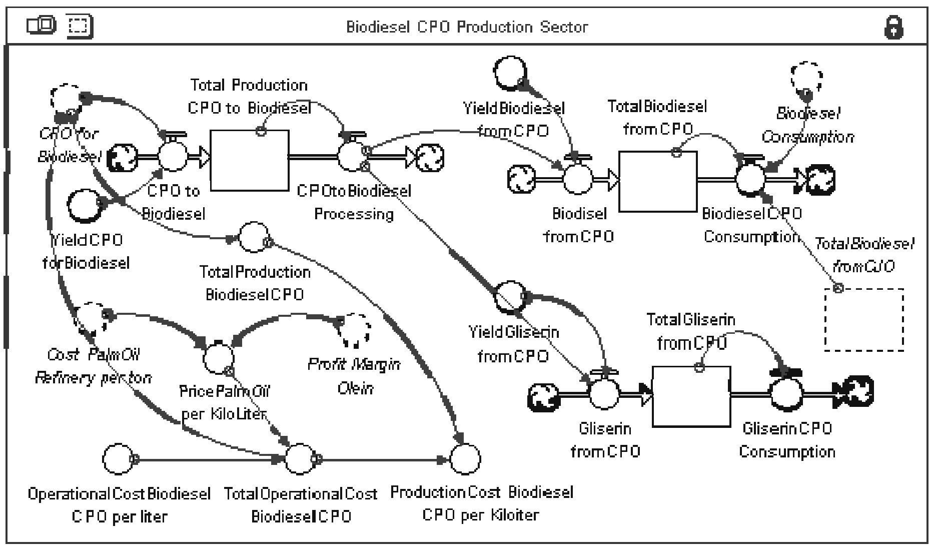
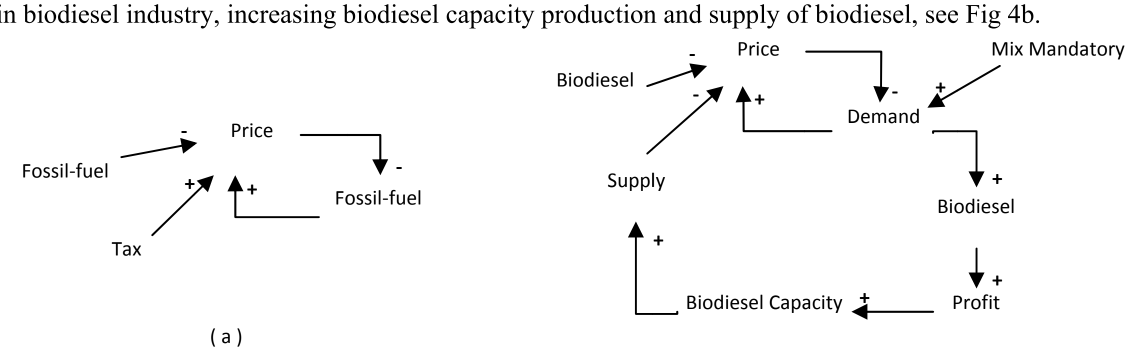


Figure 3. Stock-Flow Diagram for Biodiesel Industry Sector, CPO

3.4. Market Sector

The market sector structure consists of several subsector such as demand, mix-mandatory policy, price and gross domestic product (GDP). Every subsector affecting each others i.e. subsidy on fossil-fuel will decrease the price of fossil-fuel in the market, eventually increase the demand on fossil-fuel, see Fig 4a. Or subsidy on biodiesel and mix-mandatory policy will decrease the price of biodiesel in the market which will increase the biodiesel production, profit in biodiesel industry, increasing biodiesel capacity production and supply of biodiesel, see Fig 4b.



(b)

Figure 4. (a) Causal Loop Diagram on Fossil-fuel Market; (b) Causal Loop Diagram on Biodiesel Market

4. Result and Policy Analysis

4.1. Result

There are three government policies being tested in this model, (i) mix-mandatory, (ii) tax, and (iii) non-mix diesel subsidy. The observed output are total consumptions in kiloliter, earnings before interest tax depreciation and amortization (EBITDA) in billion rupiahs, biodiesel production in kiloliter, and carbon emission reduction (CER) in ton-C/ year. Table 1 below shows the sensitivity analysis result for each policy.

Table 1. Sensitivity Analysis Result (policies are set based on BAU)

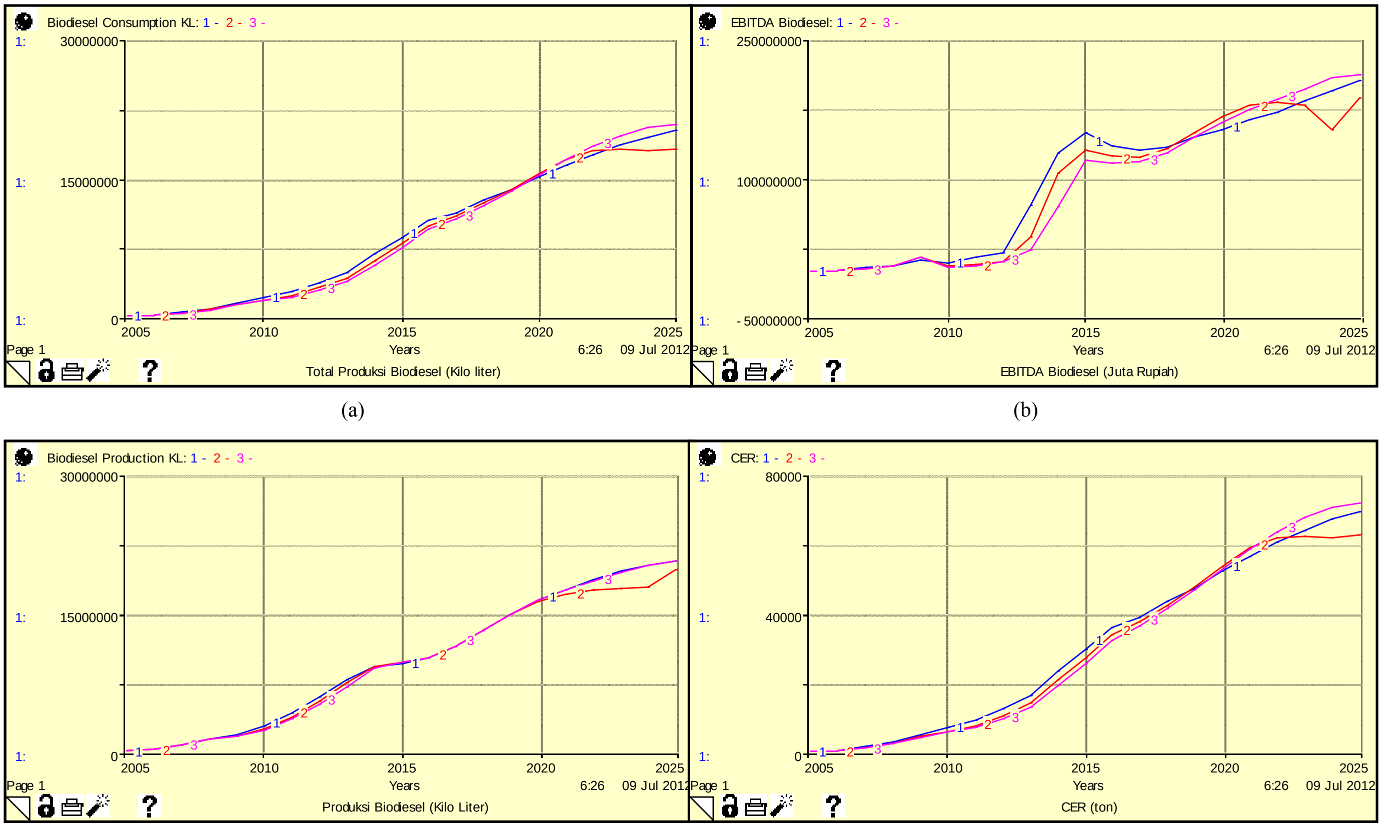
Policies	(%)	Output			
		Consumption (kiloliter)	EBITDA Biodiesel (million rupiahs)	Biodiesel Production (kiloliter)	CER (ton-C/ year)
Mix Mandatory	0.05	5,708,361	-21,595,123	17,376,570	19,711
	0.1	11,416,723	109,026,914	11,512,051	39,422
	0.15	16,375,510	183,714,170	16,483,193	56,543
	0.2	20,156,799	205,567,950	20,704,911	69,601
Tax	0.15	5,708,361	1,755,909	20,856,757	19,711
	0.2	5,708,361	1,756,387	20,856,619	19,711
	0.25	5,708,361	12,088,263	17,996,768	19,711
	0.3	5,708,361	20,449,969	20,864,164	19,711
Non-Mix Diesel Subsidy	1	5,708,361	-21,595,123	17,376,570	19,711
	0.6	5,708,361	-21,597,091	17,376,019	19,711
	0.2	5,708,361	5,880,275	14,787,638	19,711
	0	5,708,361	-8,4457,048	19,629,248	19,711

4.2. Policy Analysis

From table 1, changes 15% in mix mandatory affect the total biodiesel consumption from 5 billion kiloliters (equal to 36.9 million barrel) into 20 billion kiloliters (or equal to 131.4 million barrel) at the end of year 2025 simulation, increasing EBITDA biodiesel industry from -21 billion rupiahs into 205 billion rupiahs, dynamics biodiesel production between 11.5 to 20.7 million kiloliters (equal to 75 to 131.4 million barrel), and reducing carbon emission from 19,711 t-C/ year to 69,601 t-C/ year.

Tax policy and non-mix diesel subsidy only affect the biodiesel industrys' EBITDA and biodiesel production. Changes in tax policy affect EBITDA biodiesel dynamically between 1.7 bilion rupiahs to 20.5 billion rupiahs, and biodiesel production between 18 million kiloliters to 20.9 million kiloliters (equal to 113.2 million barrel to 131.2 million barrel). Changes in non-mix diesel subsidy affect the EBITDA biodiesel dynamically between -21.6 billion rupiahs to 5.9 billions rupiahs, and biodiesel production from 14.8 million kiloliters to 19.7 million kiloliters (equal to 93 million barrel to 124 million barrel).

Between those three policies, mix mandatory policy is the most sensitive policy to all outcomes, while the other two only sensitive to two outcomes. Thus, to achieve biodiesel contribution in 2025 implementing mix-mandatory as initiative strategy will be apropriate to spur the biodiesel consumption. Then reducing subsidy for non-mix diesel to boost biodiesel production. Last, implementing tax for non-subsidy diesel to increase EBITDA on biodiesel industry. With this strategy, at the end of 2025, the biodiesel consumption is 20,572,008 kiloliters (equal to 129.4 million barrel), EBITDA of biodiesel industry 208,988, 183 million rupiahs, biodiesel production reach 20,659,032 kiloliters (equal to 130 million barrel), and CER up to 71,035 t-C/ year, see Figure 5.



(a) (b) (c) (d)

Figure 5. Graph of Initiative Strategy to each Output

5. Conclusions and Further Research

5.1. Conclusions

This study has shown that analyzing government policies can give appropriate feedback to which policy will give significant impact on the achievement of biodiesel constribution.

The government policy on mix mandatory affects biodiesel industry up to the upstream chain, the plantation sector, as main supply for raw material. Also affects the consumption of biodiesel, CER and EBITDA of biodiesel industries themselves. While for reducing non-mix diesel subsidy and increasing tax for non-mix diesel only impacts on the EBITDA of biodiesel industries and consumption of biodiesel.

With the implementation of mix mandatory solely, the contribution of biodiesel in Indonesia mix-energy is 131.4 million barrel (equal to 51.5% from the target contribution of 255 million barrel). Eventhough the contribution of biodiesel with initiative strategy similar to the implementaion of mix-mandatory solely, but the EBITDA of biodiesel increasing more than 3 billion rupiahs which can be allocated into expanding the biodiesel production capacity.

5.2. Further Research

For further research, the extended model in potential area for palm and jatropha plantation can be added with land conversion from forest. The incentive of carbon emission trade can be considered in the next model. The easiness of access to biodiesel seller might give affect to the demand of biodiesel, also the impact of word-of-mouth from the biodiesel adaptor into those who non-adaptor migh enrich the model.

References

[1] Blumberga, D., Dzene, I., Rosa, M., Davidsen, P., Moxnes, E. "*System Dynamic Analysis for Development of Renewable Energy Resources in Country*". 29th International Conference of System Dynamic Society. Washinton D.C, USA : 2011

[2] Jupesta, J., Harayama, Y., Prayil, G. "*Sustainable business model for biofuel industries in Indonesia*" . Sustainability Accounting, Management and Policy 2, No.2 (2011) : 231-247

[3] Krismurtono, M, Naiola, B.P. "*The Challanges of Biofuel Implementation in Indonesia"*. International Journal of Basic & Applied Sicence 10, No. 6 (2010) : 36-40

[4] Handoko, Hamdan., Gumbira-Sa'id, E., Purwanto, Widodo W., Syaukat, Yusman. "*Pemodelan Sistem Dinamik Ketercapaian Kontribusi Biodiesel dalam Bauran Energy Indonesia 2025*". Jurnal Manajemen Teknologi

[5] Ministerial of Energy and Mineral Resources Regulation No. 29/ 2008, Biodiesel-Solar Mix Target for Industry.

[6] Silitonga, A., Atabani, A., Mahlia, T., Masjuki, H., Badruddin, I.A., Mekhilef, S. "*A Review on Prospect of Jatropha curcas for Biodiesel in Indonesia*." Renewable and Sustainable Energy Reviews 15 (2011) : 3733–3756

[7] Radzicki, M.J & Taylor, R.A. "*Origin of System Dynamics : Jay W. Forrester and History of System Dynamics.*" U.S Departement of Energy;s Introduction to System Dynamics. Washington.

[8] Riley, Cynthia., Sandor, Debra. "*Transitioning to Biofuels : A System-of-Systems Perpective*" . INCOSE International Symposium The Netherlands : 2008

[9] Sterman, J.D. (2000). "*Business Dynamics : System Thinking and Modeling for a Complex World*." Singapore : McGraw-Hill

[10] System Dynamics Society. (2011, June 06) "*The Field of System Dynamics.*" Retrieved June 23rd 2011, from System Dynamics Society : http://www.systemdynamics.org/what_is_system_dynamics.html

[11] Richardson, K., Cilliers, P., & Lissack, M. (2001). "*Complexity Sciene : A 'Gray' Science for the 'Stuff in Between'"*. Emergence, 6-18

[12] Hidayatno, A., Sutrisno, A., Zagloel, Y.M., & Purwanto W.W. (2011). "*System Dynamics Sustainability Model of Palm-Oil Based Biodiesel Production Chain in Indonesia.*" International Journal of Engineering & Technology IJENT-IJENS, 11 (03) : 1-2.

NGO AS TRIPLE-HELIX AXIS : SOME LESSONS

FROM NIAS COMMUNITY EMPOWERMENT ON COCOA PRODUCTION

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Abstract
Community empowerment is one of the main purpose of development in developing countries. While development only result in a ratio between the “before” and “after” condition, empowerment can keep the continuity of the development through the good relationship between related parties, in terms of knowledge production and field application. Since the parties in community empowerment are tightly related with Triple-Helix model, Non-governmental organization (NGO), as a non-profit organization in community empowerment projects, should catch its opportunities as the axis of those three helixes. The case of Nias community empowerment on cocoa production presents some lessons which seek to illustrate the links between parties in a community empowerment project. While each helix make their movements by themself, the NGO fill-in the gap in the interactions between the helixs as well as interaction among each helix. The convergence between helixs build the opportunities for each connection, so it is analyzed carefully through internal informations to find the most appropriate relationship in the field. By focusing on the gathering of new thought of the Triple-Helix approach, this paper proposes a simple model as the initial step to develop new applications of the concept, then emerges a new thought that Triple-Helix can be implemented in wider phenomenon among societies, and give opportunities for further research around it.

Keywords: NGO; community empowerment; appropriate technology; cocoa production; triple-helix

CENTER OF TECHNOLOGY (COT) FOR INDUSTRIAL PRODUCT DEVELOPMENT THROUGH COLLABORATION AND PARTNERSHIP IN POLYTECHNIC EDUCATION

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Abstract
Tri-dharma of higher education is the foundation of culture development within the university organization to improve the quality and relevance of education based on industrial needs. POLMAN Bandung as one of the applied higher education has a unique approach in developing and implementing manufacturing technologies through partnerships with industry for the purpose of increasing added value and benefits for both parties. The uniqueness of POLMAN Bandung is in process of learning, especially in the practice carried out in accordance to the character of applied technology that emphasizes on mastery of skills through production approach. That approach named Production Based Education (PBE) which has been designed to effectively transferring knowledge and technology to the students by solving industrial cases as a problem media, simultaneously. The student will gain experience through their involvement in manufacturing of industrial product development.

With this concept, a lot of application technology can be used and improved by polytechnic and industry in developing industrial product which are needed by the market, thus it will be many national products that can be made locally to increase national economic growth and provide an opportunity to have an experience for the students in entrepreneurship based on technology (Technopreneur) directly in school. Polytechnic will gain capacity in handling more innovative and creative products finding through industrial solution competitively under time, cost and the quality measures, while the industry will get the support of R&D processes that do not have to be done or provided in the company but can utilize an existing technology capabilities in polytechnic as a centre of technology (COT).

Keywords: Production Based Education, Centre of Technology, Technopreneur, Transfer of Knowledge and Technology

TECHNOLOGY READINESS ANALYSIS AND USER SEGMENTAION FOR IPTV TECHNOLOGY ADOPTION (STUDIES ON HOME PHONE USERS AND SPEEDY PT. TELKOM INDONESIA IN BANDUNG)

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Abstract
Purpose of study - Telkom has develop IPTV services (internet protocol television) as part of efforts to revitalize the business phone cord in the middle of the changing landscape of the telecommunications industry. IPTV is a high-tech product and new innovative products in Indonesia, user segmentation and technological readiness (technology readiness are the important thing to develop the best marketing strategy. The company must understand what makes each segment unique and different, and how much of the technology readiness of customers is one thing that encourages consumers to adopt new technologies.
Methodology - Using a descriptive research method, data obtained by spreading questionnaire to 400 respondents. Sampling technique using judgment sampling techniques and data was processed using two-step cluster analysis.

Finding - the results of the research then formed four segments namely Women Technoindifferent, groups of women who are not interested in the technology, Prosperous Techno Minded, people are prosperous, well-established and has positively aware to technology, Techno Net Minded Youth, young people are synonymous with the internet and aware positively to technology, Ancient age workers, among the older ageworkers. Based on the readiness to use new technologies, Prosperous segment Minded Techno and Techno Minded Youth Net is more prepared to use new technology compared to the two other segments. The people who have subscribed to the Speedy more ready to use new technologies.

Keywords: Segmentation (Demographic, Behavior), Technology Readiness (TR), Internet Protocol Television (IPTV), TwoStep Cluster

1. Introduction

The telecommunications industry is a dynamic and fast growing industry from time to time along with the development of technology, and increasingly affordable wireless telecommunications services, , this might impact the use of wire line that continues to decline and likely to only be used in offices. Changes in the telecommunications industry that occur has impact on operator revenues decreased from fixed wireline. To revitalize the business of fixed wireline telephony in the middle of the changing landscape of the telecommunications industry, Telkom modernize the access of network infrastructure on a larger scale. In addition to developing the service Speedy, Telkom's attempt to revitalize business fixed wireline, which will begin to look to the business services Internet Protocol Television, or known as IPTV (Internet Protocol Television). Kotler and Keller (292:2008) suggested that the condition often requires companies to reformulate their offerings and marketing strategies several times. Changing market conditions, growing technology and products through new stages in the interests and needs of customers.

IPTV is the first step in the deployment of multimedia applications with high interactivity on a broadband network. The research was conducted in Bandung, as one city that will be accessible by the IPTV service. Bandung is the capital of West Java province which is the third largest city in Indonesia after Jakarta and Surabaya. Bandung is a heterogeneous society signifies many different lifestyle and behavior as well as different patterns of technology adoption. Readiness for new technology that potentially Bandung residents to adopt IPTV technologies can be one of the driving user adoption rates.

IPTV classified as a high tech product marketing where high technology is something that is related to the design, development, and introduction of new product or process innovation and industry through the application of scientific and technical knowledge. In the high-tech product market is influenced by several factors, namely market uncertainty, technology uncertainty and rapidly changing competition (Mohr, 2010:7). Kotler and Armstrong

(2008:184) suggests a new product (new product) is the goods, services, or new ideas that were considered by a number of potential customers.

To compete effectively, companies do not emit their marketing efforts, but to focus on consumers who have a great chance to satisfy them. There for, segmentation is important because to develop the best marketing plan, the company must understand what makes each unique and different segments. Knowing the Technology Readiness of users becomes important because of how far the technology readiness of customers is one thing that encouraged consumers to adopt new technologies.

The purpose of the research is to determine the segmentation of the user's home phone and Speedy who have the potential to adopt IPTV technologies in Bandung based on demographic variables, Customer Behavior and Technology Readiness. This study also to know the profile and characteristics of the segments that form a cluster of home phone users and Speedy the potential to adopt IPTV technologies in Bandung.

IPTV Technology Readiness Acceptance

IPTV (Internet Protocol Television) is a multimedia service in the form of television, video, audio, text, graphics, data supplied to customers through a network IP (Internet Protocol), which guaranteed quality (QoS / QoE), security (Security), realibility and enables communication with customers in a two-way or interactive (interactivity) in "real time" (Wirawan, 7:2008). Definition of high-tech industry according to Mohr (2010: 9) is "Things relating to the design, development, and introduction of new products and/or innovation of manufacturing processes through the systematic application of knowledge-knowledge in the field of science and technical. "Understanding market segmentation according to Kotler and Keller (2009:229) is" Dividing a market into groups based on the typical buyer needs, characteristics, or behavior that may require a product or a separate marketing mix ". Basically the consumer behavior shown by finding, buying, evaluate, and manage the products or services that they hope will satisfy the needs. While the definition of consumer behavior study basically focuses on how individuals make decisions to spend its resources (time, money, and effort) in consuming a good or service, it includes consideration of what they buy (what), why they consume the product (why), when they buy (when), where they buy (where), how often buy (how Often), and how often they use it (how much) (Schiffman and Kanuk, 2007: 2).

Kotler and Armstrong (2008:184) suggests a new product (new product) is the goods, services, or new ideas that were considered by a number of potential customers. The new product may have been there for some time, but our interest lies in how consumers learn product for the first time and made the decision to adopt it. The process of adoption (adoption process) is defined as "the mental process that must be passed person to learn an innovation for the first time until the final adoption," and adoption is a decision for someone to become regular users of a product. Readiness of the technology (technology readiness) is referring to the tendency of people to embrace and use new technology to achieve the objectives at home and at work (Parasuraman & Colby, 2001:18). According to research Parasuraman (2001: 185), Technology Readiness is used to measure the readiness of the user in using new technology with four indicators of personality variables: optimism (optimism), innovation (innovativeness), inconvenience (discomfort), and insecurity (insecurity).

2. Methodology

The collection of data use a survey methods, a 400 respondent was taken by judgment sampling wich is the population of Speedy Telkom fixed line users in Bandung . Choice of this particular city was made for the belief that the people who lived in the big city are more habituated to questionnaires, and would respond, which had an impact on selection decision. The samples are users home phone service or internet services Telkom Speedy Telkom Bandung and never use the internet, so in just a sampling of respondents who met these criteria to be sample.

A questionnaire for the study was developed in Indonesian. Before the survey administration, pre-test of the questionnaire with a small group of respondents was conducted, and the results were satisfactory. The questionnaire consisted of three sections. In the first section, respondent profile was asked.The second section of

the questionnaire contained questions regarding the behavior of using the technology. And last section is adressed to know the technology readiness acceptance of IPTV.

3. Analysis and discussion

Cluster analysis in principle be used to classify objects (respondents, customers, products, etc.) or a process to summarize a number of objects become less and named it as a cluster. Basic groupings used in cluster analysis is the similarity or the distance dissimilarity Objects that are in one cluster have similar relative compared to the objects that are on the other cluster. Cluster analysis is also often called the clasification analysis (classification analysis). (Suliyanto, 2005: 140)

Two-step cluster analysis procedure is an exploratory tool designed to uncover groupings (clusters) in a set of data that are not clear. The algorithm used by these procedures have the desirable features that differentiate it from traditional clustering techniques. Two step cluster also handles the category selected for consideration as well as continuous data, and use a categorical variable with three or more levels involved.

The results of research conducted to 400 respondents from service users and Speedy Phone Home, based on the results of SPSS 16.0 for Windows generates 4 clusters as shown in the figure and table 1:

Table 1 The segment of IPTV users

	Women Techno Indifferent	Prosperous Techno Minded	Youth Net Techno Minded	Ancient Age Workers
Cluster				
Demography	• Woman • 36-45 years old • Rp. 5 – 7 million/month • Rp 1 – 3 million/month • Housewife • Highschool student	• Man • 36 – 45 years ol • Rp >10 million/month • Rp7 – Rp10 million/month • Employee • Entrepreuneur	• Teenager • 18 – 25 years old • Rp 1– Rp 3 million/month • Rp 1– Rp 3 million/month • Highschool Student • Undergraduate Student	• Government employee & Employee • >45 years old • Rp 3 juta – 5 million/month • Rp 3juta – 5 million/month • Undergraduate Student • Bachelor student

Media Usage	• TV : 9 - 12 hours at morning & noon • Internet Usage less than 2 hours/day • Internet acces through PC	• Internet subscriber • Internet spending > Rp. 300 thousands/month • Internet usage 5 to 8 hours/ day • Pay TV subscriber • Pay TV spending Rp 200– Rp 300 thousand /month • Internet acces through Laptop, PC, Smartphone	• Internet subscriber • Internet usange 9-12 hours/day • Internet spending Rp 100 –Rp 150 thousand/month s • TV 3-4 jam, malam hari • Internet access through Laptop dan smartphone • Internet access at home and *everywhere* • Not pay TV subscriber	• Internet usage 3 – 4 hours • Rp 150 – Rp 200 thousands/month TV • PC dan PC,Smartphone • Not internet subscriber
Media Purpose	Using Internet for the latest information and updating status Activity: recreation and watching televis ion Telco acces : fixed home	Using Internet for doing job and bussiness Activity : recreation, wacthing movie dan TV Telco Access : fixed home, IPTV and internet	Using Internet for updating status in social media Activity : watchin movie, and listening to the musing Telco access : Internet	Using Internet for latest information (news) and online news Activity : recreation, watching TV and listening music. Telco access : fixed home
Behavior	*insecurity dan discomfort*	*Innovativeness dan optimism*	*Innovativeness dan optimism*	*insecurity dan discomfort*
Readiness	• Low readiness of new technologies • very high TV usage • intermediate financial • IPTV Needs is low • Needs a home phone high	• The new high-tech readiness • Financial varied u se of TV high IPTV needs high	• The new high-tech readiness • Low TV usage • low financial • PTV needs high • high Internet usage	• Low readiness of new technologies • high TV usage • intermediate financi al IPTV Needs is low fixed phone need is high

The first cluster Women Techno Indifferent is a significant group of women who are not interested in the technology, they are dominated by the housewife with the need for the ultimate home phone, internet usage rates are low, they do not think the new tech products and services convenient to use, they also do not think technology can give the freedom of mobility, they use the internet is not for business purposes, the cluster is in general level of insecurity and discomfort in the cluster is high. Go to a place of recreation and watching TV is an important requirement for this cluster. Second clusters was Prosperous Minded Techno, consist of prosperous and positive thinking people to technology, which the monthly above ten million rupiahs, they mostly have an internet access, and at least have three different gadget to acces internet. and this cluster is the people who keep abreast of the latest technology, like using today's advanced technology, had no difficulty in the use of technology and this cluster was able to more easily control the daily activities with the help of technology, from the side of optimism and innovativeness cluster These high and low insecurity and discomfort. Third Cluster is Youth Techno Net Minded, this cluster consist of young people is synonymous with the Internet and technology will be positive. The cluster consists of teenager with high levels of internet usage, the need for the internet is the most important to them. They also have a high value innovativeness and optimism toward technology. These young people feel that technology gives them more freedom in terms of mobility, they used to use the Internet in their daily activities, feel they can more easily control the daily activities with the help of technology, they had no difficulty in using technology, always follow the development latest technology in the areas of interest and other people usually ask advice from them. The last clulster is Cluster Four Ancient Age Workers which consist of the old age worker, in which members of this cluster is dominated by civil servants with the dominant age over 45 years. People in this cluster have a high value in terms of insecurity and discomfort to the technology, with low internet use and they find difficulty in using the technology, but they also are people who still keep up with technology. They still need a home phone as a primary requirement. But they regard the Internet as well as needs that are important to them.

Based on the results of research conducted, author of two strategies for selecting the reference patterns of target market selection, the first is selective specialization, the company chose a number of segments, each of which is attractive and appropriate object (Kotler and Keller, 2009:250).

4. Conclusions

Home phone users and Telkom Speedy in Bandung can be divided into 4 clusters based on technology readiness variables, demographics and behavior, namely TechnoWomen Indifferent, Prosperous Min ded Techno, Techno Net Minded Youth, Ancient AgeWorkers.

In terms of technology readiness, on the second and third clusters,namely Prosperous minded techno and techno-minded youth net shows that this cluster has a high value on the innovativeness and optimism, while for the insecurity and discomfort of low value, it indicates the cluster is more prepared to use technology new.The first and fourth clusters tend to be ready to use new technologies.

Reference

Hair , Joseph.,(2010). ***Multivariate Data Analysis : A Global Perspective 7/E.*** New Jersey, Pearson Prentice Hall

Kotler, Philip & Keller, Kevin Lane.(2009). ***Manajemen Pemasaran Edisi 13.*** New Jersey: Pearson Education

------ & Armstrong, Gary.(2008). ***Prinsip-Prinsip Pemasaran Edisi 12***.New Jersey : Pearson Education

Malhotra, Naresh K. (2010) ***Marketing Research: An Applied Orientation -6/E.*** New Jersey: Pearson Education

Mohr,Jakki., Sengupta, Sanjit., & Slater, Stanley F. (2010). ***Marketing Of High Technology Products And Innovation***.Third Edition. USA: Pearson Prentice Hall

Parasuraman, A., & Colby, C.L.(2001). ***Techno-Ready Marketing: How And Why Your Customer Adopt Technology.*** New York: The Free Press.

Schiffman, Leon G. & Kanuk, Leslie Lazar.(2007). ***Consumer Behaviour*** Ninth Edition.USA: Pearson Prentice Hall.

Sekaran, Uma (2006). ***Research Methods for Business***. New York: John Wiley & Sons.

H. Shin, Dong. (2007). ***Socio-technical Analysis of IPTV : A Case Study Of Korean IPTV.*** VOL 9 Nomor 1 Emerald Group Publishing Limited

Hsin Lin, Chien., Yu Shih, Hsin., Sher, Peter. J., & Li Wang, Yen. (2008). ***Consumer Adoption of e-Service: Integrating Technology Readiness with the Technology Acceptance Model.*** Volume 3 Emerald Group Publishing Limited

Kumloglu , Hande & Nasir ,V. Ashlan. (2010). ***Discovering Behavioral Segments In The Mobile Phone Market.*** Journal of Consumer Marketing. Emerald Group Publishing Limited

Rose, Janelle & Gerard Fogarty.(2010). ***Technology Readiness and Segmentation Profile of Mature Consumers.*** Volume 4 No 1, July 2010 Australia. Academy of World Business, Marketing & Management Development Conference Proceedings

Schiopu, Daniela.(2010). ***Applying Twostep Cluster Analysis For Identifying Bank Customers Profile*** . VOL LXII No 3/2010 66-75 Romania :Journal of informatics department, Petrol University Romania

Venkatesh, V., Morris, M., Davis, G., & Davis, F. (2003). ***User Acceptance of Information Technology: Toward a Unified View***. *MIS Quarterly, 27*(3), 425 - 478.

Westjohn, Stanford A., Arnold, Mark J., Magnusson, Peter., Zdravkovic, Srdan., & Xin Zhou, Joyce.2009).***Technology Readiness and Usage: a Global-Identity Perspective.*** 37:250–265 DOI 10.1007/s11747-008-0130-0. Stanford : Journal of the Academy of Marketing Science

Genuardi, Peter.(2004). ***User Adoption Of Information Technology: Implications For Product Development Research.*** Washington DC. Master Thesis Faculty of the Graduate School of Arts and Sciences of Georgetown University :

THE DEVELOPMENT OF A METHODOLOGY FOR INNOVATION MANAGEMENT AT UTILITIES COMPANIES AT BRAZILIAN ELECTRICITY DISTRIBUTION SECTOR

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Abstract
Beginning in the late 1990s, reforms were initiated in the R&D Programs for the Electricity Sector coordinated by ANEEL (Brazil's National Electric Energy Regulatory Agency created in 1996 to regulate and oversee the electricity sector). More emphasis was given to the commercialization of successful R&D projects. In this environment, a joint project for collaboration between the Innovation Management Center of a public university and a utility company in the electricity distribution sector was started in 2008, with the purpose of developing a methodology for management of R&D,I for the utility company. What emerged as a result was a methodology for the management of R&D, I that includes the following: changes in organizational structure; systematic training programs in R&D,I, the dissemination of the goals and results of the company and new channels and processes to improve the interaction between the internal and external partners in R&D,I.

Keywords: innovation management; innovation environment, innovation laws, R&D programs, eletricity sector

AGENT-BASED MODELING ON RICE PRODUCTION FOR POLICY MAKING CASE STUDY : GARUT, WEST JAVA, INDONESIA

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Abstract
This paper try to construct an agent-based simulation based on rice production in Garut, West Java, Indonesia. The model interaction between on-farm agents is able to show, how is the behavior of the farmer, their high relationship with local loaner and the impact of farm counselor can make the dynamics of rice production.

Keywords : rice-production, agent-based simulation, policy making

1. Introduction

1.1. Background

Indonesia targeted to reach surplus of 10 tonnage of rice (equal to 3 months safety stock) in 2014 as one short-term policy to achieve food security. But there are a lot of stakeholders involved in rice industry makes the achievement of the target become more complex (Giraldo, Betancur and Arango 2009).

Generally speaking, the supply chain of rice industry in Indonesia consist of five levels, (1) the farmer who produce the rice, (2) local loaner and selling brooker (known as *tengkulak*), (3) rice miller industries, (4) rice wholesaler in production area, and (5) wholesaler in the city (Perdana and Avianto). More levels to the downstream of the chain are (6) user on rice product (i.e rice flour factories) and (7) consumer (Widyarini, Tjakraatmadja and Simatupang 2011)

During the past years, the food security policies seems to be focus only on level 1 (farmer) as net producer by increasing rice production, developing good varieties of seed and farm counseling to optimize method on planting. The food security policy seems cannot control the rice price in the market, since the wholesalers take control on creating the market price for the rice. This affect on the farmers' revenue and their low level quality of live (Widyarini 2010), so they tend to plant rice for export which can give them higher revenue. This situation create more gap on the supply and demand for domestic market.

Therefore, this paper try to model the interaction between agents in producing rice. The agents being modeled in this paper are the farmer, the local loaner (*tengkulak*), the supplier for seeds and fertilizer and the farm counselor. By using agent-based modeling, as bottom-up approach to models social system, the interaction of the agents might explain why certain policy regarding rice production is not effective.

1.2. Objectives

This paper aims to model the on-farm agents, how the farmer manage their capital to continue their rice plantation production, and the interaction between on-fam agents can affect on the rice production. The target area to construct this model is Garut, West Java, Indonesia.

2. Literature Review

2.1. Supply Chain

Production value chain is a sequence (function) of the entry of a particular input into a particular product into primary production, transformation, marketing to final consumption. Can also mean a series of connecting and coordinating institutional producers, processors, traders and distributors of a certain product. Or can be interpreted as an economic model that incorporates a selection of products and technology that set the actors in it in suchway to access the market (Widyarini, Tjakraatmadja and Simatupang 2011).

A lot of stakeholder with different objective create difficulties on managing the supply and value chain (Wood 2004). In the case of Garut, Indonesia, there are four level of supply chain. Stakeholders in each level summarize in Table 1. below.

Table 1. Stakeholders in Every Level of Rice Supply Chain, Garut

UPSTREAM	MARKET	DOWNSTREAM	LAST USER
• Farmer • Production Store • Land Owner • KUD • Rice Miller/ Dryer • Local Loaner (*Tengkulak Modal*)	• *Tengkulak* (Selling-Buying) • Decision Makers • *Transporter* • *Wholesaler* • *Retailer*	• Rice Flour Factory • Bread Factory	• Hospitals • Hotels • Restaurants • End users

(Widyarini, Tjakraatmadja and Simatupang 2011)

2.2. Relationship between each agent in every level of the chain

The relationship between each on-farm agents are described using *sociogram*, where the strong relationship represented by the (+++) and less strong relationship represented by (-). The relationship between each stakeholder in upstream level can be seen in Figure 1 below.

In this level, it can be seen that the farmer have a very strong relationship with local owner. This might be happen because most of the farmer do not own the rice plantation and most of the farmer do not have enough capital to cover the operational cost for all plantation time. So most of the farmer loan some capital to the local owner, where they can return the loan with rice. This situation creates dependency between farmer and local loaner.

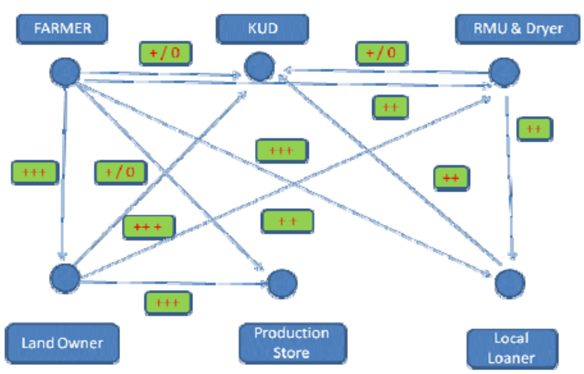

Figure 1. Upstream Relationship

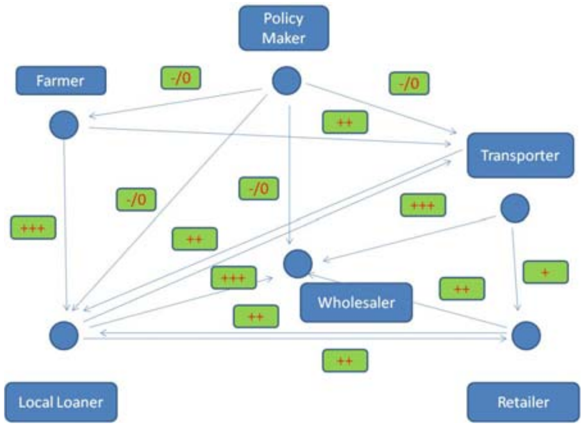

Figure 2. Market

2.3. Agent-based Modeling and Simulation

Agent-based modeling is a simulation of a system that consists of a number of software individuals, called agents. In this simulation, agents can interact with each other and with their environment (Utomo 2009). In agent based model, an agent can have one to one relationship with an actor in the real world, while interactions among agents can likewise correspond to the interactions between real word actors.

Generally, the objective of a simulation is to make prediction. However the objective of agent-based simulation is not limited to create prediction. Since social process is complex and a model is not enough to create a perfect prediction, therefore several objective that can be gain through construction agent-based model are : explanation, illuminate core dynamics, as a guide to data collection and suggest analogies.

3. Research Methodology

This paper started with literature review to recognize which agents involved in rice production system, how they make decision and how their atribute and attitude towards each other interactions.

Second, the modeling construction. With some basic assumption, the interaction between agent then constructed. Validy of the model also necessary.

Third, testing several scenario to see which policy is most sensitive to the system. Last is generating scenario which can be implemented.

REFERENCES

Darwanto, Dwidjono H. "Rice Security Based on Production and Farmer's." *Ilmu Pertanian* 2, no. 2 (2005): 152-164.

Giraldo, D.P, M.J Betancur, and S Arango. "Effects of Food Availability Policies on National Food Security : Colombian Case." *International Conference of System Dynamic Society.* 2009.

Giraldo, Diana P., Manuel J. Betancur, and Santiago Arango. "Effects of Food Availability Policies on National Food Security : Colombian Case." *International Conference of System Dynamic Society.* 2009.

Happe, Kathrin. *Agricultural Policies and Farm Structures - Agent-based modelling and application to EU-policy reform.* Institute of Agricultural Development in Central and Eastern Europe - IAMO, 2004.

Perdana, T, and T.W Avianto. "Policy Analysis on Development of Rice Industry Supply Chain using System DYnamics." Jakarta: Unit Kerja Presiden Bidang Pengawasan dan Pengendalian Pembangunan.

Perdana, Tomy, and Teten W. Avianto. *Policy Analysis on Development of Rice Industry Supply Chain using System Dynamics.* Workshop on System Modeling for Policy Development, Jakarta: Unit Kerja Presiden Bidang Pengawasan dan Pengendalian Pembangunan, 2012.

PT. Padi Energi Nusantara. "Menuju Ketahanan Pangan Nasional." Jakarta, 2011.

Robinson, Sherman, Moataz El-Said, and Nu Nu San. *Rice Policy, Trade, and Exchange Rate Changes in Indonesia : A General Equilibirum Analysis.* Wasington D.C, USA: Trade and Macroecomonics Division - International Food Policy Research Institute, 1998.

Utomo, Dhanan Sarwo. *Agent Based Model of High School Student Selection System in Bandung, Indonesia.* Bandung: Institut Teknologi Bandung, 2009.

Utomo, Dhanan Sarwo. *Agent Based Model of High School Student Selection System in Bandung, Indonesia.* Thesis, Bandung: Institut Teknologi Bandung, 2009.

Widyarini, Maria. "Pola Distribusi Beras dan Ketahanan Pangan (Studi Kasus Kabupaten Garut)." Thesis, 2010.

Widyarini, Maria. "Pola Distribusi Beras dan Ketahanan Pangan (Studi Kasus Kabupaten Garut)." 2010.

Widyarini, Maria, J.H Tjakraatmadja, and T.M Simatupang. "Metodologi Identifikasi Persoalan Sistem Rantai Perberasan." 2011.

Widyarini, Maria, Jann Hidajat Tjakraatmadja, and Togar M. Simatupang. *Methodology to Identify the Problem in Rice Supply Chain System.* Jakarta, Indonesia: not published, 2011.

Widyarini, Maria, Jann Hidajat Tjakraatmadja, and Togar M. Simatupang. "Metodologi Identifikasi Persoalan Sistem Rantai Perberasan." Jakarta, 2011.

Wood, E. "Supply Chain Management : Understanding the Concept and Its Implications in Developing Countries." *On Agriproduct Supply Chain Management in Developing Countries*, 2004.

Wood, E.J. "Supply Chain Management : Understanding the Concept and Its Implications in Developing Countries." *On Agriproduct Supply Chain Management in Developing Countries*, 2004.

HEALTH UNIVERSAL ACCESS AND INNOVATION: THE TRIPLE HELIX APPROACH IN ACTION

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Abstract
This paper presents how innovation in health/health services in IDCs - Innovative Developing Countries (developing countries with relevant investments in education, health research infrastructure, and manufacturing capacity in the last decades) can benefit from the Triple Helix approach. Diseases affect populations of developed and developing countries unequally in terms of disease burden distribution worldwide and in the R&D investment in health. Global diseases are object of intense R&D, whilst diseases related to poverty (or neglected diseases) do not receive the same attention from pharmaceutical industry. This market failure scenario highlights the role of the IDCs in the struggle against neglected diseases, since they are closer to the reality of such diseases and have an increasingly capacity to cope with health issues globally. In this sense, the case here presented is an example of the potential offered by Triple Helix approach to address the neglected diseases issue. Despite technology transfer agreements being a widespread practice of Brazilian Ministry of Health, when it comes to neglected diseases, its effectiveness is limited, due to the market failure already mentioned. Nevertheless, in an IDC environment the Ministry of Health can make use of its purchasing power both to introduce a new product in the Unified Health System, ensuring the nationalization of production, and to stimulate private investment in R&D for neglected diseases. The mechanism used in this case: the association of technology transfer to collaborative development of a new product, presents itself as a feasible option to foster innovation in neglected diseases, combining the efforts of a private company, a public R&D institution and an innovation policy with a strong presence of the Ministry of Health and respective use of State's purchasing power. We argue that the feasibility of such an action depends on the presence of two key elements: Brazil's condition as an IDC and the articulation of these three key actors as proposed by the Triple Helix Approach.

Keywords: Public Private Partnership; Innovative Developing Country; Health Innovation; Neglected Diseases, Triple Helix in health innovation.

ERP E-PROCUREMENT CONSTRUCTION COMPANY IN DEVELOPING COUNTRY

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Abstract
As the development of Indonesia's market economy, powerful construction companies in developed countries have gained the access to Indonesian construction market, and traditional construction industry has been in a more competitive case, State-Owned Enterprises (BUMN) construction companies must continue to improve their core competitiveness in order to survive and develop in fierce competition, information technology is the important aspect to improve their core competitiveness. Information construction can use many kinds of information systems; however, in view of widespread application of ERP system in foreign famous construction enterprises, it becomes a worthy consideration of ERP system.
Although many companies in developing countries may have implemented ERP systems to capture its benefits, there is a lack of examining their actual influence on ERP systems. This paper will be analyze a framework covering both the national and organizational factors to assess the influence of these ICTs on the implementation of ERP systems on construction companies in development country. Data collection is done using a survey and interviews with major players of the State-Owned Enterprises construction company in the Indonesian market. This paper also intends to take ERP system for an example to discuss the preparation, implementation and application effects of MIS. These effects reflect the enterprise core competitive ability enhancement. ERP implementation is to integrate all departments and functions across a company onto a single computer system that can serve all those different departments' particular needs. ERP implementation brings together fragmented operations, often replacing multiplicity of legacy systems. By sharing common information across an integrated set of application modules, ERP implementation can speed up construction project with main office. ERP implementation solutions are effective at streamlining business processes that cut across the functional areas of project. Findings show that certain factors have more significance in these organizations and their influences vary on the ERP successful implementation. Furthermore, the success of the ERP implementation was found to have a significant impact on achieving competitive edge for these organizations affected by both the national and the organizational factors.

Keywords: Construction company, Development country, E-procurement, ERP

1. Background

1.1 Background

Government as one of the subject building has an instrument of policy that seeks to regulate development. That is the accomplishment of policy Masterplan Economic Development Acceleration and Expansion of Indonesia (MP3EI). Aligned with national development vision as stated in Law No. 17 of 2007 on the National Long Term Development Plan 2005-2025, the vision of the Acceleration of Economic Development and Expansion of Indonesia is "Creating an Indonesia Society to be Stand alone, Forward, Fair and Prosperous".

Nearly 75% of the preconditions that support the objectives of the program is a good infrastructure and uneven, especially in the six Economic Corridor. One example of development that is currently being planned are construction of the Sunda Strait bridge and Mono Rail from Tanjung Priok to Soekarno Hatta Airport. In other words, the potential for construction have been instrumental in economic activity (MP3EI) and particularly in development activities. If a country has good infrastructureeconimic trade and education would be evenly distributed throughout the area.

Prospectively the presence of the construction services industry both small and large scale have good strategic value for Indonesia, given the large proportion of his role and about the amount of labor involved in the implementation of a project. From the above statement can be concluded that the construction company could give positive effect on economic development. But in reality, the implementation of the construction services business has some problems. According to the report building construction "BAPEKIN" in the Act No. socialization. 18/1999 and Implementing Rules of construction services, there are some potential problems that occurred in the condition Construction Services business in Indonesia. The general problem is::

1. Yet the realization of construction quality, timeliness of execution, and efficiency of resource utilization as planned.
2. Yet the realization of the parallels between the position of clients and construction company about rights and obligations in a fair and harmonious

According Syahwier, C A. Pikiran Rakyat, June 24, 2009, in fact, construction services business in West Java (as one example of areas in Indonesia) only contributes lower rate for regional economic growth in West Java, which is less than 2% even not contribute /give positive impact against other industries until 2009.

To solve the above problems, one solution is the development of a technology that can integrate the needs of central and branch, facilitate business processes so that corporate objectives can be achieved more leverage. ERP is an enterprise information system designed to coordinate all the resources, information and activities needed to complete business processes. ERP systems are based on a database and a modular software design.

ERP implementation in a construction company in Indonesia is still little practiced. The fact that information technology can enhance the competitive advantages for the company was still far from realization. Some construction companies are still using a simple application locally on the computer project, this application is just helping each other making report and not integrated with other divisions. With the ERP project progress monitoring, analysis, reporting, and inventory of goods is expected to be done in real time and integrated.

1.2 Research Purpose

The purpose of this study is:

- Designing applications that can integrate central and field.
- Appropriate design of ERP business processes in accordance with a construction company.
- ERP design that is easy to apply to construction companies.

1.3 Research Benefit

The benefits of this research is the design of Enterprise Resource Planning (ERP) for construction companies, especially in the module procurement. The results of this design is expected to be implemented and provide the solution of some problems of construction companies. So the company can improve its performance and contribute to the development of the country.

1.4 Problem Limitation

Limitation problem in the study are:

- ERP is designed only as applications that simplify business processes
- Stages of research only focuses on the needs analysis, and design but not at the stage of implementation in the field

2 Literature Review

2.1 ERP Definition

ERP is an information system designed to coordinate all the resources, information and activities needed to complete business processes. ERP systems are based on a database and a modular software design. ERP is a software that integrates all departments and functions of an enterprise into a single computer system that can serve all the needs of the company. A company or organization can choose the required modules, combined and adapted from different vendors, and can add new modules to improve performance.

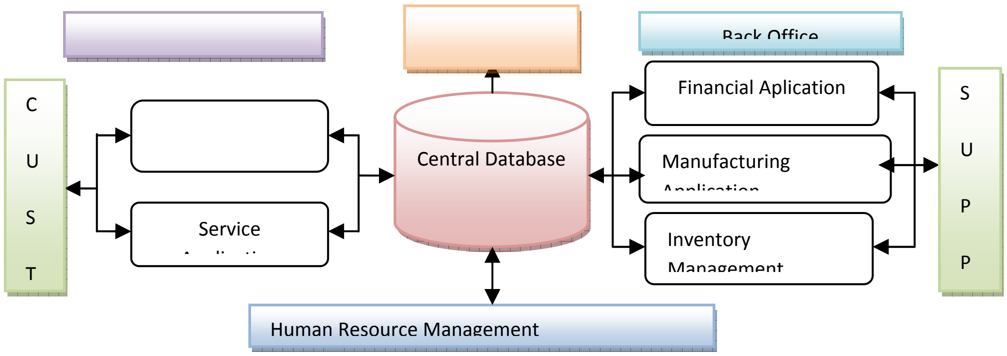

Figure 1. ***ERP basic concept***

2.2.3 ERP Implementation

ERP system implementation depends on the size of the business, the scope of change and the role of the customer. Companies require services consulting, customization, and support services. Data migration is one of the most important activities in determining the success of ERP implementation. However, data migration is the last activity before production phase. Step of data migration strategy that can determine the success of ERP implementation are: Identifying data that will be on the migration; Determine the time of data migration; Create a data template; Determine the tools for data migration; Decide preparation related to migration; Specifies the data archiving.

2.2. Construction Company

2.2.1. Construction Definition

Definition of "construction" is an activity to build facilities and infrastructure which includes building construction, civil engineer, and mechanical and electrical installations. According to the Law on Construction Services, "Construction Services" is a planning consultancy service construction, implementation services and construction supervision consultancy services of construction work. "Construction Work" means the whole or part of a series of planning and / or the execution of its oversight activities including architectural, civil, mechanical, electrical and environmental arrangement of each along with the accessories to create a building or other physical.

2.2.2. Type of Construction Enterprise

There are three categories of activities covered in this type of construction services business according to Law no. 18 In 1999:

- construction planners are providing services in construction planning services that include a range or parts of activities start from study of the development up to the preparation of construction contract documents, is generally called the Consultant Planner.
- contractor is providing implementation services in construction work involving a range or parts of activities ranging from field preparation to final delivery of the construction work, which is generally called the Construction Contractors.
- construction supervisors are activities that provide supervision services either in part or whole of the construction work starting from field preparation to final delivery of construction, is usually called the Supervision Consultant.

3 Methodology Research

This study uses a descriptive qualitative research methods. According to Maman (2002: 3) descriptive study sought to describe a social phenomenon. In other words, this study aims to describe the nature of something that is taking place at the time of the study. Qualitative methods provide the latest information so beneficial to the development of science and a lot more can be applied to various problems (Hussein Omar, 1999:81). While the guidelines in conducting qualitative descriptive method is Design Science Research Methodology for Information System, while the stages are as follows:

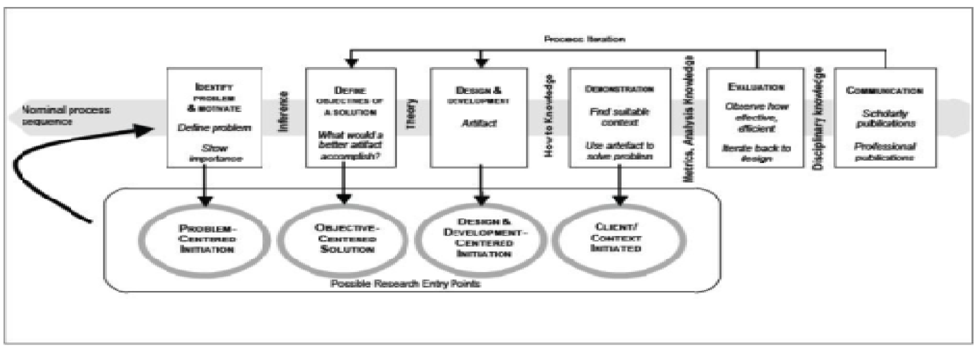

Figure 2. ***Design Reserach Methodology for Information System Process Model [4]***

3.1 Identify Problem

According Vredenbregt (1987: 38) case study is an approach that aims to maintain the integrity (wholeness) of the object, meaning that the data collected in order to learn the case study as an integrated whole, where the goal is to develop a deep knowledge of the object concerned which means that case studies should be characterized as an exploratory and descriptive research**.**

3.1.1 Type and Data Source

Types and sources of data used in this study are:

- Primary data is data obtained from the source of the first informant, there is an individual or individuals as the result of interviews conducted by the researchers. Primary data includes: sheet input form*;* sheet output form; interview record ; informants data.
- Secondary data is primary data that has been further processed and presented by the primary data collectors or anyone else for example in the form of tables or diagrams. This data is used to support primary infomation obtained either from the document, as well as from direct observation in the field (Umar, 1999:99-100). Secondary data includes: Company Organization Structure; Programs, budgets, and financial condition; Information technology training.

3.1.2 Data Collection Techniques

This study used data collection techniques of observation and in-depth interviews / in-depth interviews (Chaedar, 2002: 154-156). Both methods / techniques are explained as follows:

- Observation in question is the systematic observation of events and behavior in a social setting chosen for study.
- In-depth interview is a data collection technique that is based on an intensive conversation with a specific purpose. Interviews were conducted to obtain information regarding the various issues raised in the study.

3.2 Define Objective of a Solution

Technical Data Processing and Analysis. To analyze this research, it is done with the following steps: (Miles and Huberman, 1992: 18)

- The collection of information, through interviews, questionnaires and direct observation
- Reduction. This step is to choose which information is appropriate and not according to the research problem. Then relevant information will be treated as the basic design of ERP
- Presentation. Selected information will be presented as a description of explanation
- The final stage, is to draw conclusions. (Miles and Huberman, 1992: 18). Conclusion The analysis of the results obtained by making the design of sub ERP procurement module.

3.3 Design Module

ERP module design is based on the needs analysis of:

- Input or the data used as input → Modules required→Number of user hierarchy→Output from the ERP →Information technology risk

3.4. Demonstration

The demonstration is the output of research that can answer questions in the form of documentation of research problems. Documentation is the stage of preparing the data, process, and linkage relationships among data in existing business processes and user needs analysis as the results of the above requirements.

3.5. Evaluation

Next stage are processing, analysis, and measurement of testing result that has been done in the demo stage. Evaluation includes the comparison of the functionality of the application with the goals, solutions and quantitative measures of the system.

3.6. Communication

Communication, the results of this study will be published in a paper, which is the final report of the research has been done.

4 Design and Analysis

4.1 Input and Output Form

After conducting a survey to construction firms, there are several divisions including finance division, operating divisions, Division of Human Resources (HR), Marketing division and engineering division. Here is a sample form contained in the financial division, under this form is the form on the existing information systems:

- Input Form: Operations(form for transactions related to the project that is dropping the meeting, the proposed meeting, cash basis); Non-operating (a form for transactions outside of the project); Minit Meeting (Minit Meeting is a form provided to write a summary meeting.); Funds movement (form to view and conduct transactions (in / out), the form is already contained a table that explains the mutation of funds in and out); Negative Interest (a form to fill out a negative interest rate); Daily Rate (a form to fill out daily interest rate).
- Output Form:Report and graph (cash flow statements, positive bank interest rates, turnover analysis).

4.2 Indetification of Construction Organization

Development of the company depends on the internal organization and external companies. In general, management policy in determining the direction the company will also be determined by an enterprise environment. Environmental condition of this company will indirectly help management to identify what steps will be taken to execute corporate strategy. Organizational structure from construction company is consists of system and the scope of work of each division:

- *Board of Comissioner*
  Board of Comissioner is a ranks comissioner in the central office (head office). Ranks of the commissioners are the ones who hold full powers of the directions taken.

- President Director
  President is the highest leadership in running the company and president responsible for all implementation activities of the company.

- Director of the Division
  Division Director appointed by the President Director to lead the division directly. Division Director consists of several divisions, namely financial management division, operations division, the division of Human Resources (HR), Marketing division and engineering division. Management of each division has the task of each of which are interrelated in achieving corporate goals.

- *Human Resources*
  The division is managing all administrative and personnel matters, such as: correspondence to agencies of other companies, transfer of employees salaries, business letter of agreement, provision of office equipment, student practical work, research, etc.

- *Engineering and Marketing Management*
  In the construction company, Marketing and Management division tasked to look for tender, auction registration, managing the tender process to be the winning bidder, and sell their products.

- *Operation Management*
  Before the construction phase is running, everything is processed in this part first. Consultant planners are directly related to production management division. In the early stages, a consultant planner make a complete master plan. Then the master plan is broken down into key plans, which in turn key plan should analized by consultant planner to the engineering department.

- *EPC and Bussiness Development*
  The division has the overall responsibility of the Engineering, Procuring, and Contracting (EPC) in which this process is one of the major businesses that generate a lot of profit for the company. Another word of Engineering is a consulting, engineering charge of conducting a planning and calculating construction services without construction process. Procuring is a term which acts as a construction company in the procurement service provider, such as the procurement of property construction. Contracting is a construction company's main business.

- Financial
  Financial division is the division to arrange company finance and make an accounting report about loan and profit.

4.3 Construction Company Workflow

Basis of the creation construction firm workflow is analysis on the company's organization, the form input and output.

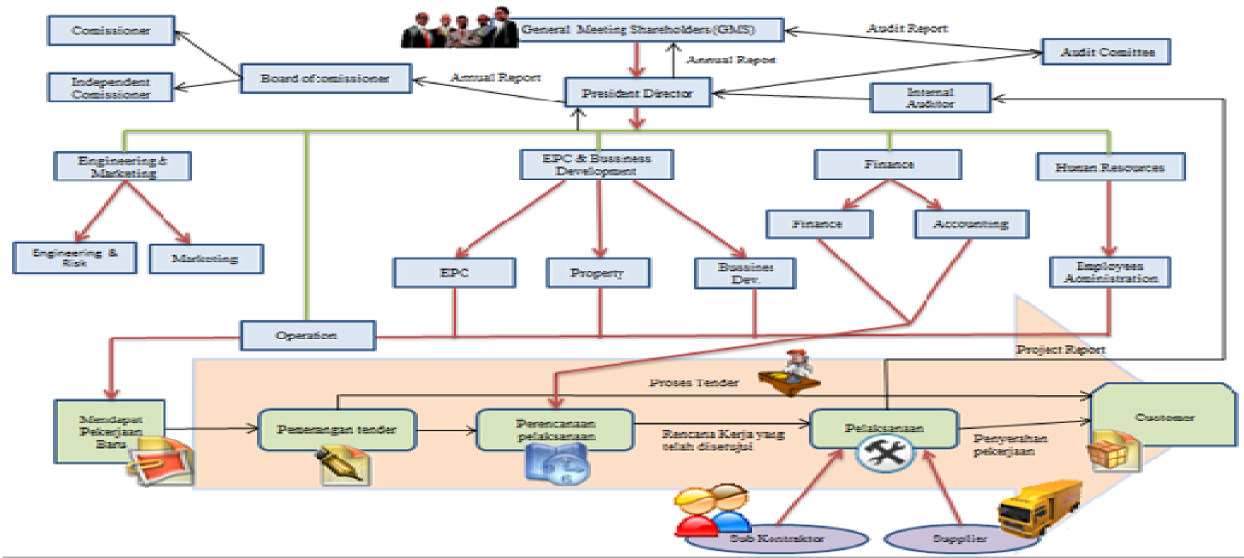

Figure 3.Construction Company Workflow

Workflow is a term used to describe the tasks, procedural steps, organizations or persons involved, both input and output information is required, and tools needed in every stage in the business process. (PennState, 2004). Workflow construction company has five stages, namely the tender selection, design development, pre-construction, construction, and post-construction.

4.4 Construction Company Business Process

The initial step should be done in analyzing and designing the company's business processes is to create a "Value Chain" of the main core process and Support Activities. Core process is a sequence of global processes that occur within the company. (Michael Porter, "Competitive Advantage"). Business process is a collection of interrelated work to solve a specific problem. A business process can be broken down into several sub processes, each of which has its own attributes, but also contribute to achieving the goals. Business process analysis generally involves the mapping of processes and sub processes in it up to the level of activity. Information technology for construction companies functioned as a support business processes rather than core business. Therefore the procurement of information technology to every part of the construction company aiming to integrate all business units to improve company performance. Value Chain Organization (classic value chain) in a construction company can be described as follows:

Support Activities

Administrative, finance infrastructure	Legal, accounting, financial management, project budget report
Human resources management	Employees, lay recruitment, staff planning, staff training
Product and technology development	Construction research, architecture design, construction engineering,market testing, R &D
Procurement	Vendor management, project funding, subcontracting,specification

Primary Activities

Inbound Logistics	**Operation**	**Outbound Logistics**	**Sales & Marketing**	**Servicin g**	**Investa tion**
examples: quality control receiving; raw materials control; supply schedules	examples: Building construtcion; infrastructure constraction; EPC (Engineering Procuring, Constructing); Branch Office Management	examples: finishing construction; order handling; dispatch; sub contructing; delivery project; invoicing	examples: customer management; vendor management; procurement management; promotion; sales analysis; market research; tender management	examples : warranty; building/ construci on maintena nce;	exampl e: stock

Figure 4. Construction company value chain

4.5 ERP Module

Business needs analysis gained from analyzing business processes and organizational structure of the company. Business needs analysis was used as the basis for determining the required modules in ERP construction company. In order to achieve the vision of its mission, in general construction company has five divisions that have different tasks. Five divisions will be the basis in making ERP modules. After analyzing of construction business needs, the next research step is to design ERP modules. At this stage of previous studies have described that there are five divisions in the construction company is exactly what will be the main modules in the ERP, main module will then be lowered back into sub-modules according to the needs of each division. ERP at the conceptual design of the construction company will be divided into several modules and the module will be divided into several modules needed again. In general approach is to offer a comprehensive approach (comprehensive), meaning that at each stage will be undertaken throughout the cycle of knowledge (tacit and explicit) in hopes the system will function operationally at each stage. The modules are:

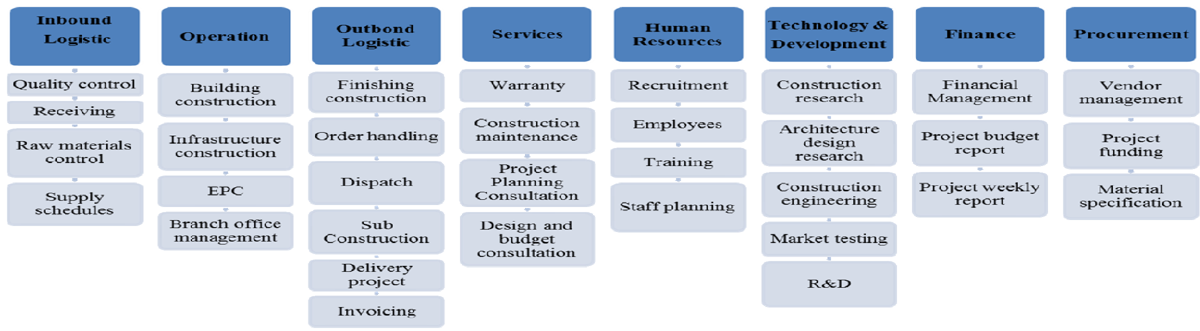

Figure 5. ERP Sub Modules

4.6 Risk Management

Assessment of the relationship of business processes with IT business objectives is the management of information technology in how to align business strategy with IT. The role and main functions of the IT governance includes two main things, there is govern and manage. (Audit Sistem & Teknologi Informasi, Riyanarto Sarno, Surabaya: ITS Press.) Arrangements are discussed about control and arrangements. While management is a way to manage specified through tactical plans and execution.

4.6.1 Risks relating to the Company's business activities

Risk management is one of important thing in the implementation of Good Corporate Governance. Explanation of these risks is to discuss the possible risks that will be generated during the running of a business venture in the company either in the form of both process and asset vulnerability (physical and information). Business risks to be one important part of the financial sector, because it influences on stock investments that are beyond the control.

- Business competition risk, in the operations it will be competition from similar companies operating in Indonesia;
- Operational risk, risk obtained during exploration to obtain data that will be in Inform;
- Risk of Termination of Contract, the Company engaged in the contracting process from the office of the main stem;
- Technology development risks, the ability to provide an information service of competitive and superior quality;
- Exploration and production risks, constraints faced in the exploration field conditions;
- Risk Lawsuit Law; parent company and subsidiaries associated with third parties so that it can lead to disputes.

4.6.2 General Risk

General risk including: Political, Economic, and Security Risk; Government Regulation Risk; Risk of Exchange Rate Fluctuations in Foreign Currency; Natural Disaster Risk; Increasing Interest Rate Risk

4.6.3 IT Risk

Stages in analyzing IT risks according to the ISO 31 000:

- Determine the context → Identification of risk → Risk analysis→ Risk Evaluation→ Risk handling→ Review and evaluation
- Some of the methods used for determining the risk of IT is:

a. scoring, seen at the aspects that include the technical complexity of the contents of the system as well as changes that occur.
b. opinion, the determination involves a personal decision, managers, business conditions and historical.

4.6.4 Efforts to Minimize or Overcome Risks

There are several solutions to minimize or overcome risks in information technology, including: Internal Mapping; Risk Assesment; Targeting; Alternative and strategic Action; Implementation, communication and monitoring; Back up data periodically; Securing data; Quality of Service Networking.

5 Conclusion

Problems faced by construction companies in the developing and developed countries both in terms of human, process, or system level will be different. From the analysis of corporate objectives, can be formulated some reason to analyze information technology planning in the construction company:

- Experts / professional can operate a system information is limited.
- The delivery of goods and services in remote areas is one of the obstacles in developing countries.
- Field project (outside the central office) making it difficult to supervise.
- The distance between field and core office inhibits an actual project conditions report.
- The possibility of corruption from budget specified is very big.
- To avoid pilferage of raw materials in the field
- Calculation of raw materials, wage laborers, and budget planning manually can take a mistakes (human error).

From the experimental results associated with the problems and objectives in general undertaken, it can be concluded as follows. Benefits can be obtained from the use of ERP:

- Decrease in inventories
- Reduction employment
- Improved service level
- Improved financial control
- Decrease the time needed to obtain information

The results were achieved after declaring the risk factors are:

- Support for the development of Good Corporate Governance;
- Decision-making based on consideration of the implementation of relevant risk;
- improvement process and results of activities;
- increased accountability of corporate management.

The success of the ERP implementation was found to have a significant impact on achieving competitive edge to compete construction companies from developed countries. By implementing ERP, hopes this application could increase company firm so the company could participate in country development.

References

Syahwier. C A., Pikiran Rakyat., 24 Juni 2009.

PT. Adhi Karya Annual Report 2010., http://www.adhikarya.co.id., 2011.

www.pt-pp.com., PT. Pembangunan Perumahan Company Profile., diakses tanggal 16 April 2012.

Sward. David., *Measuring the Business Value of Information Technology: Practical Strategies for IT and Business Managers*., Intel – Information Technology., July 2006.

Carty. Matthew M., Lansford. Richard., *Using an IT Business Value Program to Measure Benefits to the Enterprise*., Intel Corporation., Juni 2009.

Smith. Michael., Apfel. Audrey L., Mitchell. Richard., *The Gartner Business Value Model: A Framework for Measuring Business Performance*., 31., Mei 2006.

Liang. Ting – Peng., You. Jun-Jer., Liu. Ching-Chung., *A Resource-based perspective on information tehcnology and firm performance : a meta analysis. Industrial Management & Data System*., Vol.110 No.8., Emerald Group Publisihg Limited., 2010.

Ramirez. Ronald., Melville. Nigel., Lawler. Edward., "*Information technology infrastructure, organizational process redesign, and business value: An empirical analysis*"., Elsevier., 2010.

Porter E. Michael., *Competitive Advantage – Creating Sustaining Superior Performance*., New York – The Free Press., 1985.

Piselli. Thomas., *IT Value Chain Management – Maximizing the ROI from IT Invesment*., Alinean., LCC., 2003.,

Stoel. M. Dale., A. Waleed., Muhanna., *IT Capabilities and Firm performance – A Contingency Analysis of the role of Industry and IT Capability Type*., 2009.

Elzarka, H. M. and Bell, L. C. (1995). "Object Oriented Methodology for material Management Systems" *Journal of Construction Engineering and Management*, ASCE, Vol. 112, No. 4, pp 348-445

Ahmed. Syed M., Ahmad.Irtishad., Azhar.Salman., Mallikarjuna.Suneetha., *Implementation of enterprise resource planning (ERP) systems in the construction industry*., Dept. of Construction Management, Florida International University, 10555 W. Flagler St., Miami,FL 33174, USA., 2007

Connor, J., and Dodd, S.C., *Achieving integration on capital Projects with enterprise Resource Planning Systems Automation in Construction*., Vol 9, issues 5-6 pp 5515-524.,2002

Calogero. B., *Who is to blame for the ERP Failure., Sun Server Magazine*, June., PCI Publications., Austin., TX., Nov.3.2000

Lee, S., Arif, A., and Halpin, D., *Simulation Modeling by Enterprise Resource Planning implementation in Medium Sized Corporation*., Proceedings of First International Conference on Construction in the 21st Century (CITC-2002), Miami, Florida, pp 663-670.,2002

Masterplan Percepatan dan Perluasan Pembangunan Indonesia (MP3EI)., Peraturan Presiden Republik Indonesia no 32 tahun 2011., 2011.

Undang-undang tentang Jasa Konstruksi., Undang-undang Republik Indonesia no 18 tahun 1999., 1999.

MAKASSAR TECHNOPARK, EFFORT IN BUILDING A SYNERGY OF UNIVERSITY, INDUSTRY, AND GOVERNMENT AS THE BASIC MEANS TO ACCOMPLISH THE INNOVATION SYSTEM

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Abstract
The purpose of this paper is to investigate the characteristics of Technopark in building innovation-based economy and technology, to determine the role of Technopark in building local competitiveness in regional and global level, as well as to determine the potential and strategy development in the city of Makassar. The method used was by library research; data obtained from literatures such journals, magazines, newspapers, books, internet and other relevant references.

In 2002, the Government of Indonesia issued the Law No. 18 of the National System of Research, Development, and Application of Science and Technology (Sisnas P3 Iptek). The main purpose of this law is to support the National Innovation System. The vein of this system is the synergy among three main components, e.g. research institutes/universities, industry and government. The concept is known as the triple helix model or ABG (Academy-Business-Government). The synergy of academy, business and government will generate national economic wheels in information and telecommunication dynamically.

One of the efforts to approach academy group and business group is by attaining the exact instrument, the development of Technopark. Technopark is an area to accommodate research and development, as well as incubation facilities, in preparing any inventions become marketable products (Soeroso, 2009)

Technopark is an area consisted of office buildings, trade centers, research laboratories, training centers and education, and other facilities equipped by super modern infra-structure in a green environment. The main objective is to encourage the growth of regional initiatives, hence to develop the innovation and technology-based of economy.

The city of Makassar, as a center of development of Eastern Indonesia, has a potential growth for Technopark. Makassar becomes the center of business activities in South Sulawesi that still progressing, and supported by a range of amenities and facilities. In implementing the vision of Makassar to become a world city, international business and research areas are needed, thus the city of Makassar would not being filled only by "end-product consume" anymore.

Keywords: Makassar, Technopark, university, industry, government

INTRODUCTION

Background

Toward this 21st century, the world has been entering a new era of globalization, indicated by more open and worldwide role in market, investment, and production processes of transnational corporations, thus strengthened by ideology and world order under a new trade rules established by global free trade organization. Breaking through the feature in 2030 the world will be denoted by extraordinary technological advances. The economy will be fully affected by information technology, materials technology, genetics and energy technologies. This extraordinary development is triggered by a nano-technology or nano-based technologies (Kompas, May 19, 2006). Hence, only nations and states that possessing the supremacy of high and sophisticated technology will get benefits. On the contrary, nations which incapable to anticipate will be turned down, emerged from any world's progression. Accordingly, a liable and competent human resources to develop and advance technology to improve human welfare is incredibly needed.

Meanwhile, the competitive status of Indonesia still beyond the expectation, yet encounter the future filled with opportunities and challenges. Among states of over 20 million populations, Indonesia recorded 13.3 out of 100, or ranked 28 over 30 countries. Likewise, Indonesia's contribution in science, technology, and human resources (HR) of entrepreneur world gained 9.6 of 100 index value, thus ranked in the very bottom of 30 surveyed countries (Arif, 2006). Based on data of world ranking competitiveness from the World Economic Forum, Indonesia ranks 55th of 134 countries. Within the rankings, one of the elements is innovation, and Indonesia ranks at 47th, an unsatisfied position. Today's world prevails the paradigm of a knowledge-based economy. With knowledge, more welfareness can be achieved since the available resources has been utilized optimally. The more optimal utilization, the more improve competitiveness. Science and technology make the processes of goods and services become more efficient and consequently increase the competitiveness. In the past, our economy was based on natural resources, but today this condition has no longer exist. In contrast, few countries with minimal resources, or even has no resources at all, such as Singapore, Japan and Finland, can achieve tremendous prosperity. Their human resources are more superior, supported also by the utilization of capital resources, making these countries become more prosperous (Soeroso, 2009). Moreover, Prof. Barmawi stated that when the measurement of welfare is indicated by GDP (Gross Domestic Product), countries which count on science and technology might achieve the GDP above US$ 20,000, meanwhile those which still count on natural resources, attain the GDP under US$ 2,000 (Kompas, June 22, 2009). Increasing the competitiveness by science and technology requires facilities which under responsibility not only by the state, but also the active role of communities. Any progress and prosperity needs public participation. The utilization of science and technology requires a synergy from three key components, i.e. academics, industry groups, and government. Academics and researchers in universities, as well as research institutions are engaged in any invention process, finding new things. Hence, any findings impressed with a touch of economic concept by industry, turn into innovations with potential values. Accessing series of inventions and innovations to the market needs supporting atmospheres which are conducted by government through their conducive regulations. The synergy of academics, industry and government in a region or country is expected moving forward and gaining welfare.

In 2002, the Government has passed the Law No. 18 of the National System of Research, Development, and Application of Science and Technology (Sisnas P3 Iptek). The main purpose of the issue was to support the national innovation system, where its concept is the synergy among three main components, i.e. universities, industry and government, well-known as a triple helix model. One of the approach to put the academic and industry together is by applying a particular model, the Technopark. Technopark is an area which covers research and development, as well as incubation facilities in setting up findings or inventions into marketable products (Soeroso, 2009). Budi Rahardjo, an advanced IT expert, mentioned that the Technopark is purposed to establish a permanent link between academic, industry, and government. In other words, Technopark attempts to combine ideas, innovations, and know-hows of academic world and the financial capability of industrial world (Rahardjo, 2003). This synergy would create the national economy of information and telecommunications turned dynamically. Technopark also becomes the catalyst for economic growth, and in sequence encourage the growth of knowledge-based economy and technology. Being the center of growth in eastern Indonesia, Makassar city has a potential development of Technopark. Makassar city becomes the on-going center of business activities in South Sulawesi, and being supported by a variety of facilities and services, which are kept in progressing. Numbers of investors arrive, as well as open routes to Makassar from competing airlines, undoubtedly confirm the position of Makassar as the most important node services in eastern part of Indonesia.

In development of Information and Communication Technology (ICT), Makassar is directed to become a cyber city, a real movement to educate communities and literate technology. Besides, Makassar is also well-known as a learning city with numbers of universities, academics, researchers, and research institutions and development. These potentials make the city of Makassar more competitive nationally and globally through the concept of Technopark. Technopark can create a synergy relationship between the academic-industry-government to support the growth of local industries by technology transfer, joint research and regulation. Hence, this paper is purposively entitled: Initiating Technopark in Makassar (an effort in building a synergy of university, industrym and government as the basic means to accomplish the innovation system). ***Objectives*** This scientific paper is purposed to:

1. Observe characteristics of Technopark in building innovation-based economy and technology.
2. Reveal the role of Technopark in building local competitiveness in regional and global levels.
3. Find out the potential development of Technopark in Makassar city.
4. Determine development strategies of Technopark in Makassar city.

STATE OF THE ART

Definition of Technopark

Technopark was first initiated by Frederick Terman, the professor from Stanford University by leasing lands in campus area to high-tech firms, and also providing venture capital to beginner companies. The area of Stanford University known as the Silicon Valley, employ hundred of thousands workers, high-tech industries, and turnover up to millions dollars per day. The term of Technopark is derived from two syllables, „techno" and „park". Techno is the acronim of technology, and has more than one definition (based on Wikipedia). Technology is the development and application of tools, machines, materials and processes that assist humans to solve problems. Then „park" merely means an area of privately owned land, developed to offer recreation or amusements to paying costumers. Thus, Technopark is an area for technology application associated with university. There are other terms for Technopark such as science park, science city, business park, and technology corridor is also frequently used (Amir, 2010). Briefly, Budi Rahardjo, an expert in Information Technology of ITB stated: "Technopark (technology park) is a region where the technology is displayed (demonstrated), developed and commercialized." (Rahardjo, 2003:2) Extended definition of Technopark described by Aegean Tech Turkey (Aegean, 2000):

• An interesting place that contains nice buildings that, serves as a research center or science and technology center, and creates new inventions.
• Establishing link between research and development with universities for mutual benefit in technology.
• Initiating cooperation in technology between universities, industry and research laboratories.
• Generating support from Technopark management systematically in order to build up management skills, find solutions in every levels of innovation processes, as well as consultancy services and modern office facilities.

Therefore, the existence of Technopark generates a permanent link between universities and industries, and results in clustering and critical mass of researchers and industries. Also, Technopark has become one of the implementation Green Supply Chain Management (GSCM) concept, which has been long declared by experts since early of 2000s. In other words, Technopark basically needs to re-strengthen the relationship between industries and higher education which has not been run optimally. The presence of Technopark satifies higher educations, since they could face directly to real problems in industries. Students can use their experience when looking for another job or taking further study. Meanwhile, industries has access to human resources from campus.

Technopark is an organic that combines research and development of industries, universities and research institutions, where employees of companies can be educated and trained. Start-up companies based on new technologies, get support from information passages on industry and technology, and also from incubator facilities. Even trial production can be conducted by coorporate of utilization research and development facilities, thus technical innovation from such companies, along with recent development in industries can be directed (Amir, 2003).

Generally, there are two kinds of business in Technopark. First, business property (use of buildings and facilities), and second, its content business. Property business here includes facilities such electricity, roads, parks, playground, business lounge, dormitory and other facilities emphasising on technology. Technopark should have some facilities, such as business incubators, angel capital, seed capital, and venture capital. To make a synergy with science progression, Technopark should be then it should be near to universities.

In conclusion, Technopark is an area surrounded by office buildings, trade centers, research laboratories, training centers and education, and other facilities which are equipped with super modern infra-structure in a green environment, and the main objective is to encourage the growth of regional initiatives in building up innovation and technology-based economy.

History and Development of Technopark

Technopark formerly appeared in 1950's in the United States, and had driven by the needs of some scientists. They eager to reveal knowledge and in turn result into something worthy, i.e. production and marketing. Technopark was first established with the support of Stanford University in California. The Technopark is well-known as Silicon Valley, where more than 200,000 internationaly professional people working for products with higher added value.

There was an interesting phenomenon of the characteristics in technology-based IT business in starting a model in Silicon Valley, California. Its main nature of business was based on knowledge as the main capital, rather than major financial. Whereas generally, business investment has supported by venture capitals, i.e. the investors who supply investment funds which in turn become shareholding companies; or in the other way, propose the public stock in the capital markets. Moreover, this start-up business were mostly initiated by a small group of young professionals with lots of brainpower and highly self-employed. This phenomenon has demonstrated indirectly the compliance of modeling nature of SME industry which its development has been encouraged recently.

Silicon Valley in California, United States, becomes a trend for technology business, since the area is successfully developed a high-tech business, supported by Stanford University, innovators, technopreneur and venture capital. The growth of Silicon Valley as a high-tech business center has not been established through a grand design made by government or business world. The progress of Silicon Valley was due to piles of research outcomes from Stanford University compiled by technopreneurs, and funded by angel investors (Sambodo, 2010).

Silicon Valley turned into a legend since it successfully generated high-tech companies such as National Semiconductor in integrated circuit, Intel in advanced micro devices, Apple Computer in personal computers, Sun Microsystems in workstation, Silicon Graphics in 3D graphics, Oracle in database software, 3Com and Cisco Systems in network computing, and Yahoo! as a pioneer in the web search engine.

Came up later are Sophia Antipolis (France) in 1960 and Tsukuba Science City (Japan) in 1970. Until now there are more than 400 Technopark around the world and still growing. In the United States itself, there are 150 Technopark, and in Japan there are 111 Technopark, whilst in China which has started from 1980, now it has 100 Technopark.

Some countries have successfully developed Technopark in building the synergy between government, industries and universities. Since last decades, Technopark is extensively well-known and being made in such a way, especially in the U.S. and India. In 1995, an example of successful construction of Silicon Valley from third world countries has been well demonstrated by the Malaysia Multimedia Super Corridor in Kuala Lumpur, Manila Gateway Park of the Philippines, Science Park in Hsin Chu of Taiwan, and Bangalore or Cyber City of Delhi in India.

In Korea, one of the most successful example of innovation center is Chungnam Techno Park (CTP). The idea of CTP was initiated by a working group of professors through the process of sharing knowledge. Later, this initiation was fully supported by central and local governments. As a result, after 11 years of existence (1999-2009), CTP has produced 282 new industries, with total production up to US$ 6 billion. The CTP also has invested research budgets to 250 companies, with the total product of US$ 8 billion. The number of workers engaged reaches 14.884 people.

Likewise, Germany has succesfully managed in constructing a synergy model of universities-industry-government, by optimalizing one of their centers of innovation that is quite popular in Germany, Berlin Adlershof Science Park. Adlershof covers four subject industries: information and media technology, photonics and optics, microsystem and materials, and services. The synergy mechanism of Adlershof is a basic research institute, with the function to improve education and basic research. This non-university institute performs research and development, and coordinates small and medium industries for production and services. Meanwhile, the collaboration mechanism of all elements is fully coordinated by the Adlershof Science Park, independently from government.

Another example is Kyoto Research Park in Japan. It also has a proven model in successfully building synergy, in particular between academics and industries, well-known as Kyoto Solution. The core of Kyoto Solution is to fill the gap between academics and industries through an approach of meet and exchange knowledge and opinions inter-professionals. By menas the support from Kyoto Prefectural Government, this approach was able to merge the perception of innovation from educate-oriented academics with the profit-oriented industries (http://www.mediaindonesia.com). Hence, the existence of Technopark is happened to be a necessity these days, in supporting productive research and development activities.

Objectives of Technopark

Technopark is a strategic movement which has been adopted in many countries, bringing elements of research and development institutions, academics and industries, to increase the capacity role of Information and Communication Technologies (ICTs), thus enhancing contribution to the development.

Budi Rahardjo (2003:2) stated that the objective of Technopark is „to create a permanent link between higher education, industry/business/financial, and government. Technopark tries to combine ideas, innovations, and know-how from the academic world and the financial ability (and marketing) from the business world. This merger is expected to increase and accelerate product development and reduce the time required to turn innovations into marketable products, thus obtain high economical return‟.

The existence of Technopark will create a permanent link between universities and industries, resulting in clustering and critical mass of researchers and companies, make companies get stronger. The commitment and synergy of government, universities and industries are major parts of Technopark. There are some goals of Technopark gathered from a range of sources:

a. Enhance the competitiveness in business (specially the technology-mass) from local companies using campus facilities to conduct research and development. Many local companies are not capable of doing its own research and development due to limited fund, human resource and equipment; whereas universities commonly provide human resource and equipment. Funding problems could be borne jointly by several industries and/or by the government.

b. Become an instrument to develop and commerce creative ideas or findings obtained from many studies. Universities interest in obtaining financial benefit from their extended research.

c. Become an instrument to develop the technology-mass companies, or in other words as a business incubator. Universities mostly have laboratories to practice the theory given in classes. However, there is no laboratory for entrepreneurship. Thus, Technopark an incubator can be used as a laboratory for students and lecturers (Ibid, 2003: 3).

In conclusion, the Technopark generally can be divided into two functions: bringing universities research outside by creating business with industrial actors (or venture capital) that already exist (for example by research incubation); and bringing industries into universities by looking for problem-solvings in Technopark, as well as accessing experts in universities.

Benefits of Technopark

Stakeholders of a Technopark mostly are government (local government), research communities (academics), and business and financial communities. They work together to integrate use and utilization of commercial buildings, research facilities, conference centers, and hotels. For local government, Technopark creates jobs and increases local revenue. For high-income workers, Technopark is demandable because of the situation, location, and lifestyle.

One major benefits of Technopark from industry‟s site is the access to human resources on campus. Industries can access ideas, innovations, and technologies developed by researchers. Students (mostly post graduates and post doctoral in abroad) act as a very important "army ants" in research since there are numbers of them with un-expensive salaries. Industries prefer this approach because they do not need to hire permanent employees with all consequence concerns and issues (such as career development, etc.).

On the other hand, lecturers, researchers and students are pleased with the Technopark in campus, since they can directly deal with real problems faced by industries. Students can experience as a reference when they look for another job in the future, unless they interest being part of any particular company. Any co-op programs can be set up to support these exchanges.

Fully-loaded technology industries will always need research and development, so the function of universities and research institutions is very significant. Nevertheless, universities and research institutions in Indonesia do not seem appreciating industries as clients or partners in long-term. Mostly, they have relationship with industries only in short-term in discontinue and unsustainable projects.

Therefore, Technopark can become a permanent liaison between universities and industries. Even Technopark has become an area to link higher institutions and industrial world, current process of interaction between researchers on campus and industries mostly dealt by a personal approach. Thus, research incubations have always performed in ad-hoc method and inefficient iterative process. According to its objectives, Technopark (include incubators) should have economic values, eventhough not clearly visible. Technopark indirectly contributes to economic growth in the concerned region from new companies that provide jobs.

Technopark in Indonesia

The concept of Technopark is not well developed in Indonesia. Until now there are only several locations been existed, e.g. Sragen, Solo, and Jababeka Bekasi. In some areas, Technopark has been facilitated by government and private sectors, whilst Puspiptek Serpong was highly invested by the Indonesian government. In Technopark of Puspiptek, some links with business groups have not been optimally performed, however, supporting adequate facilities of science, technology and human resources are available. In Solo Technopark, there is un-optimal synergy with academics, lack of contributed inventions. In Sragen, there is still early stages of establishment, and depends on training centers using advanced technology facilities. Meanwhile the Jababeka Bekasi, there is no direct representative of government present (Soeroso, 2009).

The development of Technopark in Indonesia is adapted to potential and uniqueness of each area. For example, Cimahi Cyber City concentrates on game and animation industry, Solo Techno Park focuses on engine, and Sragen applies model of work training centers. Adoption of Technopark concept has been well-done in some areas, such as Bali (Balicamp), Yogyakarta, Bogor (Bogor Cyber Park), Toba (Toba Tech), Batam and Jakarta (Kemayoran Cyber City). However, these developments are more focused on infrastructure development rather than human resources. This led to the development of Technopark suspended due to un-formation of ecosystem, from natural resource shortages, chain with other industries, and understanding market needs.

In early 2010, an enthusiastic news came from Bandung, West Java. The academics of Institute of Technology Telkom (ITTelkom) Bandung initiated the Technopark. Unlike other Technoparks in Indonesia, the BTP focuses on information and communication technology (ICT). The BTP was built on a-5 acres area provided by Telkom Education Foundation, located in the area of Telkom, precisely at the campus of Telkom Institute

Technology, Terusan Buah Batu Dayeuhkolot, Bandung. There are 52 equipped ICT labs, and at least 215 ICT researchers. Laboratories are grouped into Electronic Systems (4 labs), Networking and Multimedia Systems (3 labs), Information Signal Processing (3 labs), Communications Transmission (4 labs), Communication Systems (3 labs), Information Theory and Programming (4 labs), Software and Data Engineering (4 labs), Computer and Network Systems (4 labs), and Industrial Engineering (15 labs). The BTP focuses on 8 areas, i.e. Research and Development, Vocational Training and Human Resource Certification, Consultaty, Facility Provider, Business Mediation, Technical and Business Information Center, Product Certification, and Production Support.

Researches generated in BTP will be categorized into basic and applied research. Applied research will be developed in PDT (Telematics Design Center), becoming the design of products and some prototypes will be made prototypes, in the form of systems and devices. Indirectly, the patent will thrive from the BTP. The prototypes will pass the certification procedure for feasible mass production. The BTP has been targeted to produce prototype each year, which will readily absorbed by industries. In the year 2010, there was a target of 10 industrial cooperation. The BTP is expected to facilitate telecommunication investments in Indonesia to local content. Currently, telecommunication investments in Indonesia recorded approximatelly Rp 300 trillion, but only 5% have been exploited by local content (Mapiptek, January 15, 2010).

WRITING METHOD

Type and Purpose

This is a descriptive paper on idea to build the Technopark in Makassar, as an effort to build synergies of academics, industries, and government to accomplish the innovation system. The paper is supported by literature reviews and objective facts, with a systematic way to solve a problem or answer the formulation of the problem. Data were obtained from newspapers, journals, books, papers and internet.

Paper Writes-up

The writing was completed by library research, include search, identify, study, analyze and evaluate the relevant literature with the object of research or writing problems. Data and information collected subsequently selected to obtain data and information most relevant to the issues that are reviewed and further developed into scientific work. Scientific work is expected to be structured as initial assessment or preliminary study to be developed in the future.

DISCUSSION

Technopark Characteristic in Building the Innovation-and-Technology-Based Economy

Technopark emphasize the word of „technology‟ in its function. Technology is perceived as a combination between technique, as a way of doing things effectively and efficiently, and socio-cultural-economy structure, in which the setting up concept of Technopark may involve surrounding communities. The Technopark can be settled for promotion (realising the process of science and technology on marketing communication effectively), markets (implementing social processes through activities needed for communities), and culture of science and technology (embedding values, attitudes and science-and-technology-oriented behaviour). Thus, efforts towards the proficiency in science and technology, as well as its utilization can be accomplished synchronously. The standard characteristics of Technopark as determined by Bappenas (2004) described as follows:

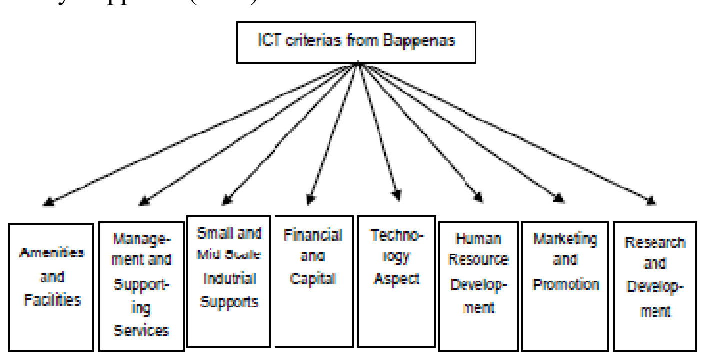

Figure 1. The criterias of Technopark (Bappenas, 2004).

Nurhadi (2010) mentioned, the characteristics of an ideal Technopark at least provide three main accesses. First, access to experts on campus. In field, many industries found (in particular lower-middle class) have no experts. As a result, their production can not run optimally. Thus, with the access to experts, industries can offer cooperation in research. Researchers can have right and relevant object studies, while industries support with maximum fundings. Second, access to campus facilities, such as libraries, equipment, laboratories, and internet center. Commonly, universities have a comprehensive range of equipment which is hardly owned by small-mid scale companies. And third, access to business center, the interface between universities and industries. For instance, when there‟s a crisis in an industry, the business center provide consultation, since there are many human resources and facilities might assit in problem-solving. The business center, if managed properly, can bring considerable economic benefits. Thus, the Technopark should have a link with venture capital for investment.

There is a debate concerning the physical location of Technopark. Most people suggest that it should be located nearby campus, and some even argue that it should be a part of campus. This due to the availability of researchers, who are also lecturers, and they do not need to travel out of campus. Hence, the Technopark would be surrounded by intellectuals.

Nonetheless, some people recommend the Technopark still part of campus but stand outside and still nearby campus. This due to eliminate the intervention of campus managers, which businessman highly want to keep away from this matter. For instance, the working time can be more flexible, and even accessable 24 hours per day, whereas universities in Indonesia often limit the access time to campus. So, ones propose that the Technopark should be adjacent to campus. However, both within or outside, the Technopark location should be close to campus to gain more convenience of Technopark facilities (Rahardjo, 2003: 5).

Technopark is closely related to economic development based on knowledge and innovation. As clearly known, today‟s world implement the prevailing paradigm of knowledge-based economy. This economic era is often so-called the era of „modern economy‟ (ME) or „new economy‟ (NE). The NE actually involves the whole industry (in broader sense) which compete in new „order‟ and „way‟. The NE not only include high-tech, but rather more innovation in doing business, related to products (goods/services), sector, and so on. Productive activities in the NE facing issues and similar characteristics, which are fast, global, networked, has increasingly influenced and determined by knowledge, filled with technology and innovation (Sussongko, 2006).

The NE is loaded with rapidly dynamics of change, borderless activities, and networks that become the pattern daily relationships which determine how the value-added process is done, and how they interrelate and competitiveness is built and maintained. More important is the fact that knowledge and innovation is considered as the main driver (the driving force) for the NE.

The utilization of science and technology is a synergy of three key components: universities or academics, industries or business groups, and government. This is known as ABG (academician, businessman, government) synergy, which is an upmost concept in Technopark, and the heart of innovation systems. However, the performance of innovation systems have not been well-established when existence of classical problem, the lack of synergy of triple helix elements, still comes up (Muzakir, 2010).

Synergistic relationship between academics, business and government will enhance the development of Information and Communications Technology (ICT), including infrastructures, applications, contents, contexts and regulations. The relationship of ABG synergy supports the growth of local industries through technology transfer, joint research and regulatory supports. The growth of small-medium industries (SMI) based on science will increase economic growth as well as strengthening competition in the SMI joint free trade flows (IT Telkom Today, 2010).

In order to improve competitiveness, particularly in local competitiveness in regional and global order, the role of local governments on the one hand should be improved to provide a conducive atmosphere. In various aspects, the role of financial sector has not been optimal. In this case, financial institutions of venture capital have not been sufficiently developed, so it is necessary for government to support for research and development institutions, and obtain research funds from venture capital.

Technopark Role in Building Competitiveness

Porter (1994) in Tumar (2008) states that „the term of competitiveness similar to competitive, and the term of superior competitive similar to competitive advantage. Optionally, Tumar Sumihardjo (2008:8) provides an explanation of the term competitiveness, i.e. „The word of competitiveness means strength, and the word of competitive means reaching beyond, or differ from the others in terms of quality, or have certain superiorities. Thus, competitiveness might imply the power to become superior in certain aspects of a certain person, group or institution‟.

Similar idea disclosed by Rangkuti (2003) in Kuncoro (2008), that is „Competitive superiority is a specific activity that is developed by a company to get more superior from its competitors‟. The competitiveness level of a person/organization/institution depends on affecting factors. In the territorial (regional) scale, Tumar Sumihardjo (2008: 37-38) identify main and specific indicators as determinants of competitiveness. The scope of competitiveness in macro scale includes: (1) local economy, (2) open minded, (3) financial system, (4) infrastructure and natural resources, (5) science and technology, (6) natural resources , (7) institutional, (8) governance and public policy, and (9) management and micro-economy. Therefore, the Technopark plays crucial role in improving competitiveness since its main function is to strengthen the role and synergy of ABG components. Hence, it is very reasonable if one indicator of the current progress of science and technology in many countries is the presence of Technopark, maximizing its function and role.

In Technopark, the harmony of ABG elements has always desired as a major capital in increasing regional competitiveness. Not only the harmony, but also support of involving communities (societies) as part of interaction chains. Communities/societies involvement is absolutely necessary when the paradigm of development has shifted towards participatory-based development, and development is more legitimate when people directly involved in the decision making process and have spaces to perform a supervisory function. More clearly, communities participation may support local government programs, such Technopark, due to 'ownership' in communities.

Through collaboration, the local government can concentrate with all related elements, including research institutions, business communities, universities, non-governmental organizations and other supporting institutions. The regions can build competitiveness effectively through increased productivity. The productivity is related to how to utilize every resource wisely and creating more value for each product. Hence, the existence and performance of supporting industries such as technology, agriculture, fertilizer, farmers associations, research institutes and so forth, which involved in a community have to be supported. A clear vision and strategy is the key to build the competitiveness in a region, in order to compete with other regions. A good strategy is not only directing differently but also be able to deliver high value into societies. When region changes, Indonesia has been changed. And all of the above can be carried out in an organic unity of Technopark. As a growing city, Makassar has potential development for Technopark. The presence of Technopark is important since it serves as research and development area that produces innovative products and services for industry sectors with a touch of park, along with the vision of Makassar city becomes the world class city. With these figures, it is questionable if the city of Makassar as a center of growth in eastern Indonesia, have no initiative to establish a real Technopark. This can be started by empowering existing potential, whether owned city government, educational institutions, and industrial world. Moreover, the Makassar city has a carrying capacity of well-established industrial investment in many fields.

Potential Development of Technopark in Makassar City

South Sulawesi is one of the provinces in Sulawesi island, surrounded by national waters and adjacent to international trade routes, thus it is possible to play a role in the growing Asia region. The former major economy which has growth in the United States and Europe, now shifted to Asia such as Japan, China, India and Indonesia. Indonesia is active in regional economic forum together with Brunei, Malaysia and the Philippines, in particular involves in cooperation of tourism, fisheries, marine and air transportation, infrastructure development, trade and investment.

The Governor of South Sulawesi Syahrul Yasin Limpo mentioned that Makassar has a lot of uniqueness or superiority. First, the position is in the very center of Indonesia or so-called the Centre Point of Indonesia (CPI). Second, as the capital of South Sulawesi, Makassar is the gateway to eastern Indonesia. Third, being a regional service center of eastern Indonesia, since it has many branch offices or facilities for working areas in eEastern Indonesia, both government and private institutions, such as banking, telecommunications, and regional air defense. Fourth, as a barometer of economic, political and security, as well as the powerhouse of draft regional economic of eastern Indonesia, since there is a dependency of distribution production in and out of eastern Indonesia (Makasssarkota.go.id).

It is not surprisingly if the Makassar city has a vision to become the world class city. It is an attempt to promote the city of Makassar becoming an advanced area and accountable in global arena. To achieve the vision, an international business and research area is needed, instead of being a city full of consumer of finishing products. A good example has been proven in Songdo City, South Korea. Formerly, the city was really poor due to monetary crisis hit in the region, but then finally raised up by relying on international business areas and research centers. Likewise, some developed cities which realize the importance of research to produce their own needs, have already established land areas or research lands. There is Shanghai Science Land in China, Kuricibha Techno Park in Brazil Malaysia Multi Medis Super Koridor in Kuala Lumpur (Makassar Terkini, 2007). Makassar has now being developed into a metropolitan city. A range of buildings fill every corner of the city. Eventhough there are many office buildings, hospitals, hundreds of educational areas, recreational parks to shopping malls spreading all over the Daeng city, but there still one thing is missing, the Technopark.

From the economical view, particularly industries, data the BPS Makassar in year 2000 showed a rapid growing economic activities, characterized by increasing numbers of trading companies, reached up to 14.584 units, consisting of 1.460 large trades, 5.550 medium trades and 7.574 small trades. There are 21 major industries and 40 middle industries concentrated in the Biringkanaya District, and other 5 units secondly concentrated is in the district of Tamalanrea and Panakkukang. Furthermore, in the year of 2006, there were 228 units of industrial enterprises in Makassar, which employ labors as much as 19.283 people. These numbers has been increased from 143 unit in previous year, with 17.767 workers (Makassar dalam Angka, 2006). These increasing figures should encourage the government to locate and establish a Technopark in Makassar.

Development Strategy of Technopark in Makassar

Among theoretical basis referred to establish a Technopark, Wired Magazine quoted that to develop the Technopark, there must be a prepared university/research institution producing innovative products. Related to development indicators, Wired Magazine believe that developing technology needs an established company. This means that ideally the location of Makassar Techno Park area, as much as possible close to the location (agglomeration) of large industrial/business activity centers (Rahardjo, 2003). Since the development of Technopark Makassar is designed to balance the interests of three major stakeholders, the industrial sector, education and local government, thus ideal location for this area is based on proximity of city facilities and easy access.

Referring to the Perda No. 6 of 2006 on spatial planning of Makassar city from year 2005 to 2015, the government realized the importance to develop an integrated research area and divide iton 13 draft integrated areas in the city of Makassar.

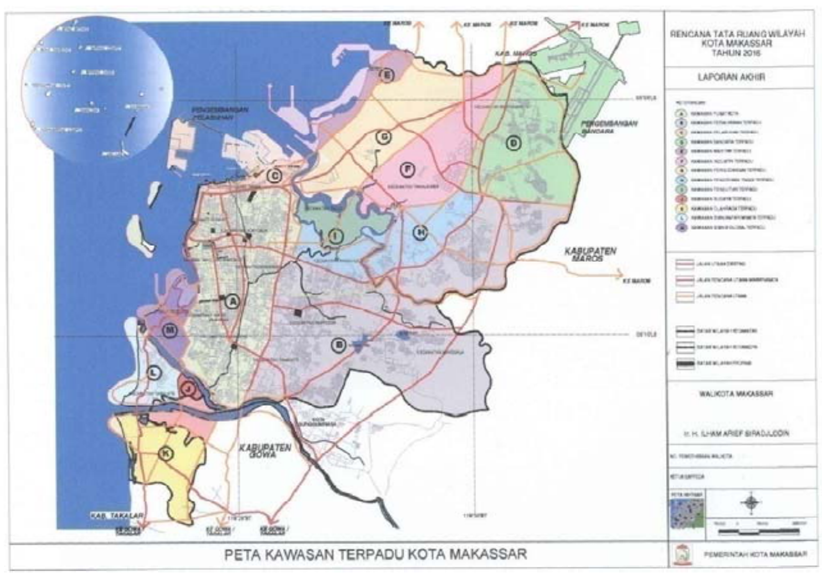

Figure 2. The map of 13 integrated areas in Makassar city.

In this Makassar spatial regulation of 2005-2015 stated that Integrated Research Area is a region that is directed and designated as areas with a concentration of research and development activities that comes with supporting complete and synergic activities in a system of solid space. Mission of the Integrated Research Area is to realize the function of the area as a center of science and technology as the agropolitan-and-maritime-based Technopark, which becomes the main determinant in the accelerated development of Makassar. Accordingly, establishing a central green area built in the form of Garden Cty, and Riverside city as an effort to provide clear boundaries between conservation areas and urban culture areas, and encourage supporting spaces.

The Technopark integrated research area will be sited in mid part of eastern city, in the area of Tallo District, namely Lakkang, which is located in the delta of Tello River. In the spatial plans of Makassar, Lakkang is located in the integrated area of education, close to several universities, including University of Hasanuddin.

Figure 3. Lakkang area from Google Earth

Lakkang is the name after an "island" of delta of the Tello River. This land formed from sedimentation process throughout the Tello River. Unintentionally, this growing soil over 200 km2 turned out to be the barrier and occupied by approximately 125 families, who mostly work as farmers and fishermen. In terms of access, there are no bridges or roads connecting to Lakkang which is surrounded by rivers. Boat services are the major transportation from Lakkang to the mainland. There are only two alternative ways, i.e. along the river, by boat from Tello Rivers behind the Governor's Office, and toward the sea, by boat from Paotere harbour (Ujungpandang Express, 1 November 2009).

In development design of the integrated research area, the primer pathway would utilize Tello Rivers as the infrastructure, passing through western area of integrated warehouses. This pathway acts as natural link to the integrated research area located in the delta of Tello Rivers, the Lakkang island, as well as the port area.

The area of Lakkang covers 409.86 Ha, and wpould be equipped by water transportations. Development of water transportation includes the main lines of Tello Rivers that passes from northern to eastern part of research area. This path performs as border and natural connection within warehouses, industrial, and integrated education areas. The support line utilizes Pampang River in west side along the south. This south line is adjacent to the center of Makassar and integrated education (Haian Fajar, May 11, 2009).

The integrated research area or Lakkang Technopark will also be equipped with an open 15% green space, or 61.48 acres of 409.86 Ha of integrated research area. The development will include secure open green space around the delta of Tello Rivers area, setting the water catchment around the river, setting lower reaches of the watershed, and arrange plants along the green belt. The Lakkang Island will be used as a research center for integrated science and technology, to meet the accelerated skill development in particular field of maritime and agropolitan. The land is built into a green area which covers minimum 60% (Harian Fajar, May 11, 2009). The regional development strategy used in the integrated research area, includes:

- Develop Lakkang Island area, which is the delta of Tello Rivers, as a center for integrated research and development of science and technology, in congregate with accelerated development of skill in particular fields of maritime and agropolitan.
- Establish a green zone with the minum 60% ratio of green coverage.
- Develop a new road network infrastructure across the region as well as the infrastructure of sewage treatment plant to maintain the existing environmental quality.
- Encourage development of centers of low-density residence, environmentally tourism facilities, business facilities and water sports.
- Plan the informal sector areas with prospective and highly attraction on strategic locations.

This area also functioned as a central target of green areas. Therefore, extensive open green space in the Integrated Research targeted 55% of total region. The population limited to 21.073 people, will occupy the 29.33 ha residence area. In associate with the idea of building a Technopark in Makassar, the Municipal Government has an important role as the facilitator, and attempt to connect the output of practical educations and higher educations, and have a linkage with industrial sectors, by developing the idea of Makassar Technopark. This would integrate a variety of interest issues related to the development and application of strong human-resources-based technology, thus capable in supporting labor resources for industrial sector mediated by other stakeholders, either the government, investors or public.

Another important agenda is the development of innovation system by stengthening institution, the research council. The Research Council, both at national and regional level, is believed to be one of requirements in innovation system. In many countries, the main role of research council usually as an advisory board (advisory council) for the government. Research council is basically different from the board policy (policy council) which normally has a role as decision makers. In the context of Technopark development in Makassar, the Research Council can maximize its role. Another important thing is how consistent the spatial and territories plans. Plenty of criticsm judge the difference allocation from former plan of the city. Some areas that have been rmarked for green space, already converted to business areas. Likewise, the residence areas, have been mixed up with other means, including transformation into central business district. As a result, chaos is inevitable. If consistency put aside according to the planning rules, these urban areas would be well ordered.

In related to the development of Technopark, Budi Rahardjo stated several problems oftenly arise among others: it is not clear what can be offered by the universities to attract interest from industry to use Technopark facilities. Does the facility is only a form of rent, or an access to existing intellectuals in campus? Sharing mechanism, ownership, and other matters related to financial aspects remain unclear. The current rules are considered less favor to researchers, as well as mechanism on selection topics to be incubated (Rahardjo, 2003).

To perform the synergy of ABG, lesson-learned of other countries requires at least three things (Muzakkir, 2010). First, strengthening the soft technology such as knowledge sharing, cultural cooperation, and ABG networking in particular and society in general. Second, pushing back the efforts to make innovation centers that already exist in Indonesia as an ecosystem center for innovation system. These efforts must be supported by other countries by adopting successful factors while adjusting the character and potential of the region. Third, attempting to encourage better governance institutions, which encourages innovation center to become an icon for national and regional development (Muzakkir, 2010).

SUMMARIES

Conclusion

From earlier descriptions, it can be concluded as follows:

1. Experience in many countries shows that a technology center such Technopark might assist the development not only of the region but also of the nation.
2. Technopark also plays an important role in facilitating new businesses that produce high quality and innovative products, export-oriented and widely international market.
3. Technopark establishment can be a suitable way for SME development in Indonesia. In the concept of Technopark, the main character is a knowledge-based business.
4. The ABG (Academics-Businessman-Government) synergy in Technopark has always desired as a major capital in increasing regional competitiveness.
5. It is the time to accomplish the vision of Makassar city as the world class city by initiating the Technopark. This can be started by empowering existing potential, owned by the government, educational institutions, and industrial world.
6. The planning of Makassar Technopark will be located in the Lakkang Island, the delta of Tello Riversm which covers an integrated area of educations and industries.

Advice

1. The government should initiate the follow-up on development plan of Technopark in Makassar throughout studies and research collaboration with LIPI, BPPT, Depkominfo and discussions to all stakeholders for the preparation of vision, mission and roadmap development of Technopark.

2. Researchers from universities and public should continue to conduct assessments, research and development of Technopark.

Recommendation

- Need a follow-up for development of Technopark, in the form of scientific studies, specially in determinate spatial location of Makassar Technopark.
- Need a movement in funding Technopark facilities, not only from the state budget but also from investment of software and support from the business communities, and backed up by a comprehensive master plan of Makassar Technopark.
- Need an ad-hoc committee of relevant governmental agencies for fundraising.
- Need a real step in strengthening the innovation system, by research councils.
- Need a consistency of spatial planning from the government of Makassar.

Policy Implication

1. Development of Technopark in Makassar requires a pattern of cooperation and ABG synergy as well as support from communities.
2. Technopark development also requires socialization in the community in preparing this technology-literate societies.
3. Need a real efforts to improve the capacity of policy makers and stakeholders of the innovation system through forums such as training, TOT, seminars, and workshops.
4. Need a movement in campaign to gain awareness among political parties, politicians on regional and national innovation. These political leaders painting Indonesia with changes in innovation policy in the future.
5. Maximize the role of mass media to contribute in "heating up" the spirit of national revival of innovation, including in the regional.

References

Aegean Tech (2000). *Definisi Technopark.* Aegean Tech, Turki.

Amir, A. (2010). *Pemenuhan standar ICT-Technopark, Analytical Hierarchy Process (AHP) terhadap ICT Technopark di Jawa Barat dan Banten.* Jurnal Puslitbang Depkominfo edisi 15 Januari 2010.

Arief, M. (2006). *Menuju Pendidikan Masa Depan.* Makalah seminar Nasional-LP3M Intim, tanggal 13 Mei 2006.

Bappenas (2004). *Tata Cara Perencanaan Pengembangan Kawasan untuk Percepatan Pembangunan Daerah*. Bappenas, Jakarta.

Harian Fajar (2009). *Makassar Dilengkapi Transportasi Air.* Rubrik Metro. Edisi tanggal 11 Mei 2009.

Harian Kompas (2003). *Kantor Ristek Tetapkan Tonggak Iptek Pembangunan Indonesia 2020.* Edisi tanggal 6 Mei 2003.

Harian Kompas (2006). *Sewindu Reformasi, Mencari Visi 2030.* Edisi tanggal 19 Mei 2006. Hal. 37.

Hillner, J. (2000). *Skunk works, startups, and hungry VCs are making these 46 hubs the hot spots of the global high tech network.* Kolom Venture Capital, Wired Magazine. Edisi 8 Juli 2000. http://www.wired.com/wired/archive/8.07/ silicon.html

Kuncoro, E. A. (2008). *Leadership sebagai Primary Forces dalam Competitive Strength, Competitive Area, Competitive Result guna Meningkatkan Daya Saing Perguruan Tinggi*. Penerbit Alfabeta, Bandung.

Majalah Makassar Terkini (2007). Edisi tanggal 3 September 2007.

Majalah Mapiptek (2010). Edisi tanggal 15 Januari 2010.

Muzakir, A. I. (2010). *Modal Sosial untuk Penguatan Inovasi Nasional.* Artikel Media Indonesia, edisi tanggal 22 Juni 2010.

Nurhadi (2010). *Menggagas Technopark di Surabaya.* Rubrik Metropolis, Harian Jawa Pos, edisi tanggal 12 Maret 2010.

Pemerintah Kota Makassar (2005). *Perda Kota Makassar No. 6 Tahun 2006 tentang Rencana Tata Ruang Wilayah Kota Makassar 2005-2015.* Tanggal 10 Desember 2005.
Rahardjo, B. (2003). *Science and Technology Parks di Perguruan Tinggi.* Pusat Pembinaan dan Pengembangan Program Diploma (P4), Bandung.

Sambodo, A. (2010). *Perkembangan Bisnis Teknologi di Silicon Valley.* Artikel blog http://imambudiharjo.wordpress.com, tanggal 2 Februari 2010.

Soeroso, S. (2009). *Technopark, Sarana Pendukung Daya Saing.* Artikel Iptek, Suara Karya, edisi tanggal 1 September 2009.

Subagyo, I. (2009). *BPPT Dampingi Penguatan Inovasi Unggulan Daerah.* Edisi tanggal 7 September 2009. http://www.bppt.go.id.

Sussongko, S. (2006). *Pembangunan Daerah, Mendorong Pemda Berjiwa Bisnis*. Penta-Rei, Jakarta.

Tresmianti, R. (2010). *Bandung Techno Park Siap Wujudkan Masyarakat Informasi.* Artikel pada website IT Telkom Today, edisi 14 Januari 2010.

Tumar, S. (2008). *Penyelenggaraan Pemerintah Daerah Melalui Pengembangan Daya Saing Berbasis Potensi Daerah*. Penerbit Fokusmedia, Bandung.

AGENT-BASED MODELING FOR EFFICIENCY POLICY OF HOUSEHOLDS' ELECTRICITY CONSUMPTION IN BANDUNG CITY

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Abstract
Some experts in Indonesia claimed that government subsidy in electricity, for holding down the electricity fares, has encouraged extravagant use of electricity. Therefore, the Government Budget (APBN) Burden for this subsidy becomes higher than it necessary. Some experts have argued that this money can actually be used for other necessary and urgent spending such as infrastructure development. The purpose of this research is to build an agent-based model and simulation to explore the dinamic of electricity consumption in Indonesia, especially in Bandung City. Several interviews were conducted about households' behaviors in consuming electricity to build the model. Then, the parameter was set based on the data collected with questionaire and secondary data source. The model was tested for its validity and sensitivity to the change in the controlled parameter. The simulation is expected to provide the government with a combination of electricity fare to various households electricity market segments to ensure an economic use of electricity.Some scenarios were run and the emergent property, the whole system electricity consumption,were observed to find out the best policy to encourage efficient use of electricity in the system.

Keyword: Agent-based modeling, electricity consumption, electricity fare

1. Introduction

There are extensive debates regarding government subsidies that had made an overuse, inefficient use and wastage on Indonesian natural resources (Perspektif Baru, 2002; Nugroho, 2005; Mukhtasor, 2010). Perspektif Baru (2002) and Nugroho (2005) especially stated that energy subsidies had create dependency on fossil fuel (BBM), and hamper the development of better national energy management and new energy infrastructure. The United Nations also had called some developing country to lower or even diminish the government subsidies on energy as one approach to deal with the climate change issue (The UNEP Division of Technology, Industry and Economics, 2008; Aguilar, 2009). Right now, the government keeps monitoring this electricity fare issue in order to decrease the state budget (APBN) burden caused by the electricity subsidy.

Recent approaches that relate electricity fare to the electricity consumption is by using mathematical modeling and experiment (Gleerup, Larsen, Leth-Petersen, &Togeby, 2010; Abduh, Abdullah, &Zain, 2003; Matsukawa, 2001; Aubin, Fougere, Husson, &Ivaldi, 1995; Sexton, Sexton, Wann, & Kling, 1989). While the Indonesian government used survey on economic ability to determine the electricity fare. This approach is only valid for studied interval and if agent's attribute is fixed. This study propose an agent-based simulation model to explore the dynamics of electricity consumption in Indonesian electricity market, especially in the household market. The resulted model and simulation is able to create and simulate scenarios. Besides providing a better understanding, simulation results can also give suggestions to government on policy regarding to electricity fare, to encourage economic use of electricity.

Based on the problem statement above, thus, the research questions of this study are: (1) Can the proposed mechanism mimic the real condition of electricity demand in Bandung? (2) What the impact of different type of electricity user to the whole electricity demand? (3) What is the impact of electricity fare to the economical use of electricity? (4) What is the best policy to support energy efficiency in Bandung?

Therefore, the objectives of this research are: (1) to identify mechanism of electricity usage in the households. (2) To identify the sensitivity to electricity fare in the households. (3) To generate scenario to explore the dynamic in the electricity demand. (4) To find the best policy on electricity fare.

2. Literature Review

2.1 Agent-Based Modeling and Simulation

To simulate, mean to imitate a process by another process (Hartmann, 1996). Simulation means driving a model of a system with suitable inputs and observing the corresponding outputs (Axelrod, 2003). Furthermore, an Agent based simulation can be defined as a simulation of a system that consists of a number of software individuals, called agents. In this simulation, agents can interact with each other and with their environment (Gilbert, 2004;

Smith &Conrey, 2007). In agent based model, an agent can have one to one relationship with an actor in the real world while, interactions among agents can likewise correspond to the interactions between real world actors (Gilbert, 2004).

Until now, there is no standard methodology to create an agent based simulation (Gilbert, 2004). But, there are several steps that usually carried out to create a good agent based simulation. The first step is to identify the target system clearly. A target system is the real phenomenon that we want to understand better (Gilbert, 2008).After the research objectives are defined, we need to gather the body of theory about the target system.In the second step, the simulation design is started. In this step, first all types of objects in the simulation are defined (Gilbert, 2004).After that, attributes for all objects are specified.The third step is to design interactions among objects.

In the fourth step, we need to consider how to validate the model. Unfortunately, validation for an agent based model is very difficult (Gilbert, 2008). But, there are several concepts that can help us in validating an agent based model. There are two steps of validation in agent-based simulation: internal validation and external validation.In external validation, agent-based model accuracy can be classified into several levels (Axtell & Epstein, 1994):

1. Level 0: the model is caricature of reality that able to visualize agent's movement.
2. Level 1: The model is in qualitative agreement with empirical macrostructure.
3. Level 2: The model is in quantitative agreement with empirical macrostructure.
4. Level 3: The model is in quantitative agreement with empirical microstructure.

The last step is to conduct virtual experiment in order to generate some hypotheses or explore the dynamic of social phenomena.

In this research we what to know about the dynamic of the households' electricity consumption and conduct experiment to understand the relationship between electricity price and the electricity consumption pattern in households. The term dynamic here refers to how a single agent decision rule and interaction between them affect the whole electricity demand pattern, as the emergent properties we want to observe. Therefore, a modeling and simulation using agent-based model is appropriate for this research.

2.2 Agent-based simulation researches in electricity

There are several agent-based research have been conducted regarding the electricity, but most of them discuss about the electricity market (Möst& Genoese, 2009; Zhou & Chan, 2009; Harp, Brignone, Wollenberg, &Samad, 2000). An electricity market is a market that resulted from the restructurization of electricity infrastructure and the liberalization in the electricity supply system (Zhou & Chan, 2009). This process moves the electricity industry from vertically integrated monopolies to multiple independent companies and replaces the centralized cost-based market to supply- and demand-based competition. This structure is not yet applied to Indonesia electricity supply system. Even though today, power generation can be done by private company, the distribution, selling and buying process still conducted by the state owned electricity company (PT. PLN).

These papers observe how the electricity price is formed by the electricity market, and sometimes relate the price with green technology and reduction of carbon production in electricity industry (Möst & Genoese, 2009). Therefore, some of them become decision making tools related to electricity market, such as Simulator for electric power industry agents (SEPIA) (Harp, Brignone, Wollenberg, & Samad, 2000), Electricity market complex adaptive systems (EMCAS), Short-term electricity market simulator-real time (STEMS-RT) and National electricity market simulation system (NEMSIM) (Zhou & Wai Kin Vicotr Chan, 2009).

3. Model Building

The model was construction begin with interview with several PT. PLNs' customers, especially regarding their decision making process in using electricity appliances. Based on the interview, several assumptions were deducted. These assumptions then verified and consulted with other PT. PLNs' customers to ensure its validity. Based on these assumptions an agent-based model then constructed. This section will explain briefly the stage in building the agent-based model.

3.1. Basic assumptions in model

In building the agent-based model, several assumptions are used this study. First, for electricity users in R-1 segment, users with the same electricity capacity are assumed to have same behavior in using their electricity appliances. However, users in R-2 and R-3 segments are assumed to have a same electricity behavior within its segments. Therefore, there are six behaviors in using electricity appliance: users with 450 watt, 900 watt, 1300 watt, 2200 watt, R-2 users and R-3 users."R" is the code used by PT. PLN to distinguish between its consumers (i.e. "I" isfor Industries, “R” is for households and “B” is for businesses). These segmenting (e.g. R-1, R-2 and R-3) and its name are already set by PT. PLN. All of the electricity appliances are grouped based on its relative importance to users. Thus, appliances in the same group have the same importance for an agent.Electricity consumption for each electricity appliance is generated randomly, but still based on real data about each type of the electricity appliances.The real data here, obtained from the manufacturer, are the range of each electricity appliances consumption rate. Based on this rate or distribution we generate a random number that represent appliances electricity consumption. Another assumption is all agents have budget level for electricity cost, and if the cost is higher than its budget, then the users will try to lower its usage time of specific electricity appliance based on its relative importance for the users. However, if the cost is lower than the budget, it can do nothing or add another electricity appliance. Electricity budget is fixed throughout the simulation. This budget is initiate in the beginning of the simulation and cannot changed during the simulation is run.

Next assumption used in building this model is that electricity sources from PT. PLN were assumed to have unlimited capacity, however it is not continuously available for its customers. Therefore there are probabilities of blackout occurred during the simulation is run. Agents were also assumed to stay in its place/address as long as the simulation run and cannot move to another place. Agent’s electricity capacity was assumed to remain the same and it cannot increase nor decrease its electricity capacity. For example, if an agent has electricity capacity 900 VA then, it cannot decrease its electricity capacity to 450 VA or increase it to 1300 VA once the simulation is run. Lamp is assumed to be very important for all agents and won’t be considered when an agent has to decrease their electricity consumption. However, its consumption will still be calculated in the model. And the last assumption is all agents reconsider their strategy regarding the time and electricity appliances used in their households monthly.

3.2. Agent specification

In this study, agents are the electricity users which are the PT. PLN (persero) consumer in the household segment. PT. PLN used code “R” to represent this segment. The agents itself will be divided into several type of user based on their attributes, which includes their electricity capacity, personal values, and electricity appliances owned.

Every agent has attributes that represent their attribute in real life regarding the electricity consumption. As mentioned before, this attributes are their electricity capacity, electricity cost and consumption, personal values, electricity budget, electronic appliances owned and neighbor address.

Table 1Agent’s Attributes

No.	Attribute	Type	Description
1	capacity	Number	Electricity capacity of the agent
2	agent_cost	Number	Electricity cost that have to be paid by the agent as much as his consumption
3	agent_consumption	Number	The electricity consumption of the agent
4	minimum_bill	Number	The minimum cost that has to be paid by the agent regardless its electricity consumption
5	time_difference	Number	The time difference of usage time of an appliance that the agent have to reduce to meet its budget
6	lov	String	Personal value based on List of Values (LOV) of the agent
7	change	String	The variable that connecting the lov variable to the relative importance of each appliances for the agent
8	budget	Number	The maximum amount of money allocated by the agent to pay the electricity bill
9	daily	List	A list of electricity consumption (watt) of daily appliances owned by the agent
10	daily_time	List	A list of usage time of daily appliances owned by the agent
11	kitchen	List	A list of electricity consumption (watt) of kitchen appliances owned by the agent
12	kitchen_time	List	A list of usage time of kitchen appliances owned

No.	Attribute	Type	Description
			by the agent
13	entertainment	List	A list of electricity consumption (watt) of entertainment appliances owned by the agent
14	entertainment_time	List	A list of usage time of entertainment appliances owned by the agent
15	personal	List	A list of electricity consumption (watt) of personal appliances owned by the agent
16	personal_time	List	A list of usage time of personal appliances owned by the agent
17	others	List	A list of electricity consumption (watt) of other appliances owned by the agent
18	others_time	List	A list of usage time of other appliances owned by the agent
19	position	Number	Show the position of electricity appliance in their list to be change its value
20	neighbor_address_x	List	The list of x coordinates of the agent's neighbors
21	neighbor_address_y	List	The list of y coordinates of the agent's neighbors
22	address	Number	The address of the agent's neighbor that its choose to imitate

3.3. Environment specification where agents interact

Agent will interact with other agent of his nearest neighbor using the micro-world environment. A micro-world environment that is basically a two dimensional grid can "wrap" in any direction. This environment has been used by many agent-based researches, such as Druckenmiller and Acar (2009), Schwoon (2006), and Clough (2007). For example, should agents wander off the left edge of the world, they would appear on the right hand side of the grid; this is viewed as a *torus implementation*. The illustration on this environment can be seen in Figure 1.

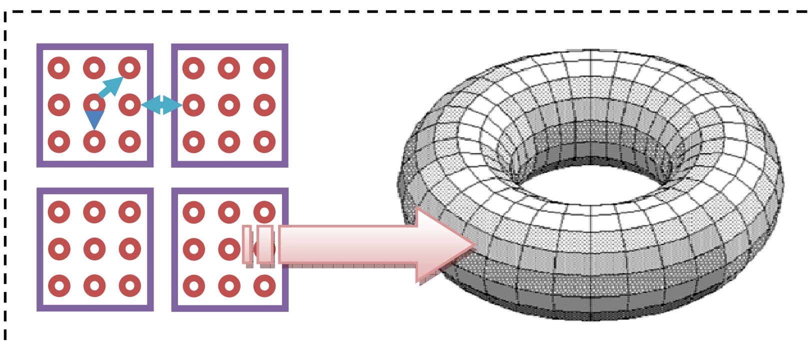


Figure 1 Simulation Environment

This kind of environment used to represent human networking, as 8 nearest neighbor of an agent is the nearest network which is had by an agent. In the real world, this nearest neighbor can be the agent's family, neighbor, close friend, or close relatives.

3.4. Decision rule specification and interaction among agents

In agent-based model, the behavior of agent in the model was represented by its decision rule. This decision rule were constructed by using basic assumption and based on the interview conducted in the beginning of this research. Then, the parameter set in the decision rule was gained from the survey conducted as explained in the next section.

Decision rule of each agent, in this case household, can be seen in Figure 2. After 30 iterations, each agent will calculate its electricity cost and compare it with its budget. When agent's budget is more than its electricity cost then agent will make decision whether he add appliance or do nothing. If the agent chose to add appliance, the new appliance to be added is imitated from one of its neighbor.

However, when agent's budget is less than its electricity cost, agent can choose to react directly by decrease usage time or decrease appliances used, or learn from its neighbor efficiency strategy. If agent react directly and chose to reduce usage time then it will select one group of applianceswith the lowest importance according to the agent. It will then reduce the usage time of one appliance from the selected group randomly. If agent chose to decrease appliances used, then it will also select one group of appliances with the lowest importance. However, one appliances choose randomly from that appliance group will no longer be used by the agent. If agent chose to learn from its neighbor then the agent will imitate neighbor's usage time by copying one of neighbor appliances usage time owned by the agent and that neighbor.

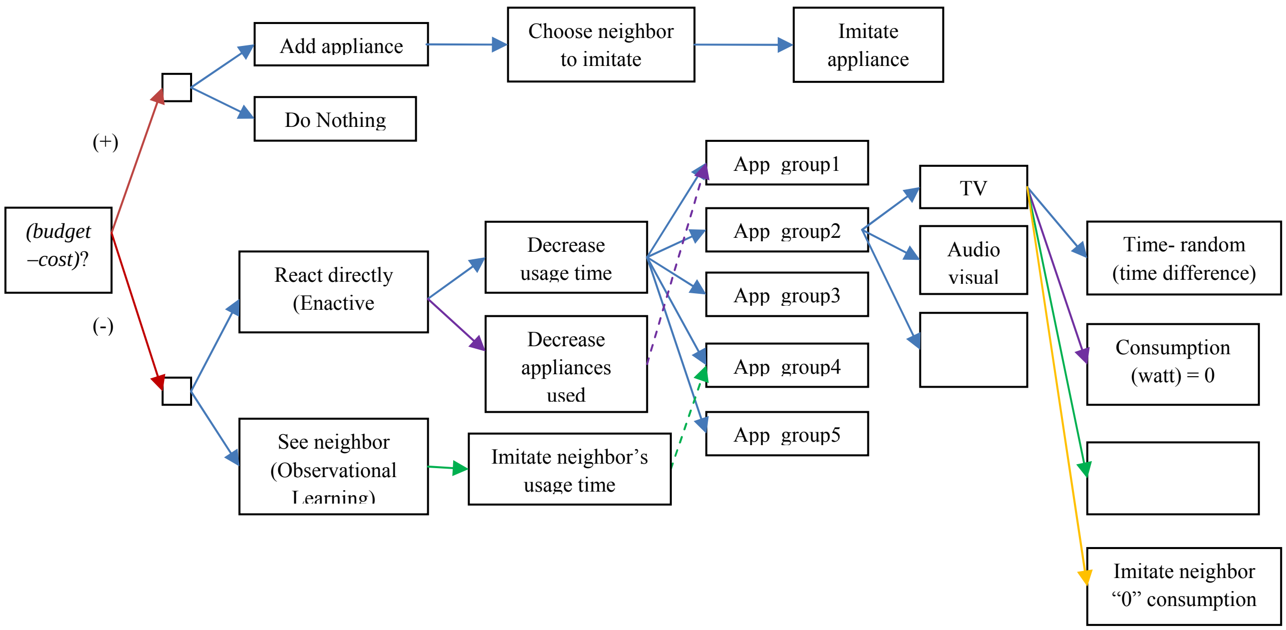


Figure 2 Agent's Decision Making Process

3.5 Data Collection for Setting Parameter

For setting parameter in this model, data collected from secondary sources as well as primary sources. The following sections explain briefly about both of the data collection process and the analysis of the data to be used in the model.

3.5.1 Primary Data

Primary data collected using questionnaire. We spread 150 Questionnaires, but only 86 questionnaires are returned and only 81 questionnaire data can be used for analysis in this research. Therefore, the return ratio is 57.33%. The number of population was 524,970 households; therefore the sample is about 0.02% of the total population. Even though this number was small, the data obtained from the questionnaire can be used for the model since in agent-based model the model is validate with certain validation procedure as describe in the previous section about agent-based model.

The questionnaire had 5 sections. First section is about general electricity data of a household. In this section, respondent asked to fill in the information about their households' electricity capacity, their monthly electricity bill and the budget they are willing to pay each month for electricity cost. From this section the data for parameter budget is obtained. The result of this section is as follows.

Table 2 Summary of the Respondents

Capacity	Num. Respondent	Percentage
450	14	17.28%
900	24	29.63%

1300	17	20.99%
2200	20	24.69%
R2/R3	6	7.41%
Total	81	100.00%

Second section is about the respondent personal values. In this section, respondent was asked to rate several statements regarding their personal values with 7-point likert-scale. These statements were taken from Kahle, Beatty, & Homer (1986), translated to Bahasa Indonesia and adjusted with Indonesian common culture. The data obtained then used to grouped the respondents into segments, a cluster analysis procedure suggested by Hair, Black, Babin, Anderson, & Tatham (2005) was performed. This procedure includes two traditional approaches, hierarchical and nonhierarchical clustering. Both approaches were used sequentially. First, hierarchical cluster procedure was conducted to obtain an initial description of potential clusters within the data uses average linkage with Squared Euclidean distances. From this step four and five clusters were obtained as seeding point for the non hierarchical cluster analysis. The second step involves a k-means clustering procedure that is nonhierarchical. Raw data for items include in each factor of benefits sought from apparel provides the basis for the clustering procedure. From this procedure, five clustes solution was selected because it gave more specific characteristic to the cluster than the four cluster solution.

Third section in the questionnaire asked about the importance of electricity appliances for the households. For this section, respondent was asked to rate several electricity appliances based on their importance using 7-point interval scale. Respondent was asked to rate 1 if the appliance is not important in their household and rate 7 if the appliance is very important for their households. The electricity appliances listed in the questionnaire is based on the common appliances owned by Indonesian households, which are obtained from interview with several members of Bandung's' households.

Two last sections required the respondent to fill in its electricity appliances ownership and its electricity appliances usage time. The electricity appliances listed in this section is the same with in the previous section. However, in this section respondent is asked to fill how many of those appliances they owned and the type of the appliances.Similar list of electricity appliances also used in this section and the respondent is asked to check how their usage time for each appliance is the ranges for usage time.

3.5.2 Secondary Data

Secondary data obtained from PT. PLN Bandung City Branch. The data including number and composition of PT PLN's customers, total electricity consumption, total electricity cost, and electricity fare system used in PT. PLN. All of these data can be seen in Table 3, Table 4, and Table 5.

Table 3 PT. PLNs' Customer in Household Segment in Bandung City

Fare Category	**Number of customers**	**Percentage of customers**
R-1 s/d 450 VA	83,857	15.97%
R-1 900 VA	259,915	49.51%
R-1 1.300 VA	102,011	19.43%
R-1 2.200 VA	56,055	10.68%
R-2 > 2.200 s/d 6.600 VA	19,148	3.65%
R-3 > 6.600 VA	4,034	0.77%
Total	**525,020**	**100.00%**

Table 4 Electricity Consumption and Revenue Data from PT. PLN

	Consumption (in kWh)		**Revenue (in Rupiah)**	
Consumer Segment	**August 2010**	**September2010**	**August 2010**	**September2010**
R-1, 450 VA	10,015,592	13,161,106	4,284,230,237	4,307,952,368

R-1, 900 VA	41,813,406	42,282,626	23,828,783,904	23,999,787,777
R-1, 1.300 VA	22,864,261	23,042,905	16,415,878,989	16,936,972,639
R-1, 2.200 VA	18,970,407	18,983,349	13,894,147,561	14,268,701,372
R-2	11,249,111	11,345,463	9,292,585,046	9,662,323,565
R-3	4,766,591	4,803,422	5,467,083,210	5,545,179,547
Total	**109,679,368**	**113,618,871**	**73,182,708,947**	**74,720,917,268**

Table 5 Electricity Base Tariff for Households Data from PT. PLN

ELECTRICITY BASE TARIFF FOR HOUSEHOLDS					
No.	**Fare Category**	**Electricity Capacity**	**Regular**		**Prepaid**
			Fixed Cost (IDR/kVA/month)	**Usage Cost (IDR/kWh)**	**(IDR/kWh)**
1	R-1	450 VA	11000	Block I : 0-30 kWh : 169 Block II : 30-60 kWh : 360 Block III : > 60 kWh : 495	415
2	R-1	900 VA	20000	Block I : 0-20 kWh : 275 Block II : 20-60 kWh : 445 Block III : > 60 kWh : 495	605
3	R-1	1300 VA	*)	790	790
4	R-1	2200 VA	*)	795	795
5	R-2	3500 - 5500 VA	*)	890	890
6	R-3	More than 6600 VA	**)	Block I : H1 x 890 Block II : H2 x 1380	1330

Note:

*) With Minimum Bill (MB):

MB1 = 40 (Usage Time) x Electricity Capacity (kVA) x Usage Cost

**) With Minimum Bill (MB):

MB2 = 40 (Usage Time) x Electricity Capacity (kVA) x Usage Cost Block I

Usage time : kWh per month divided by Electricity Capacity (kVA)

H1 : Frugal usage limit percentage to national average usage time x Electricity Capacity (kVA)

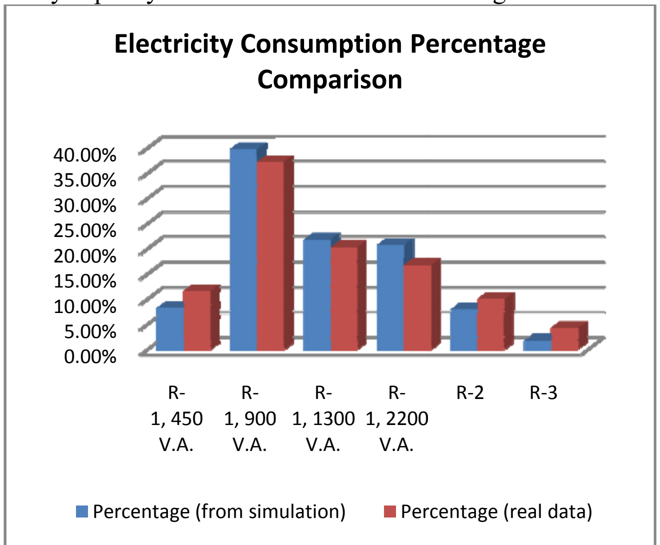
H2 : Electricity Usage (kWh) - H1

The frugal usage limit percentage and national average usage time is set by the directors of liability company (persero) PT. PLN with approval from Ministry of Energy and Mineral Resources

4. Experiment Result and Discussion

4.1 Model Validation

To do the validation input data to the model is the proportion of consumer segments and the distribution of electricity appliances in August 2011. The simulation was run with 10,000 agents and runs about 30 times. Thus, the simulation output from the second month is compared to the real data about electricity consumption and electricity cost in September 2011. This one month run to validate the model is chosen because of the assumption that the agent is fixed and he cannot change its electricity consumption. In this time frame the change in the number of agent and the change in the agent electricity capacity in the real world are still not significant.



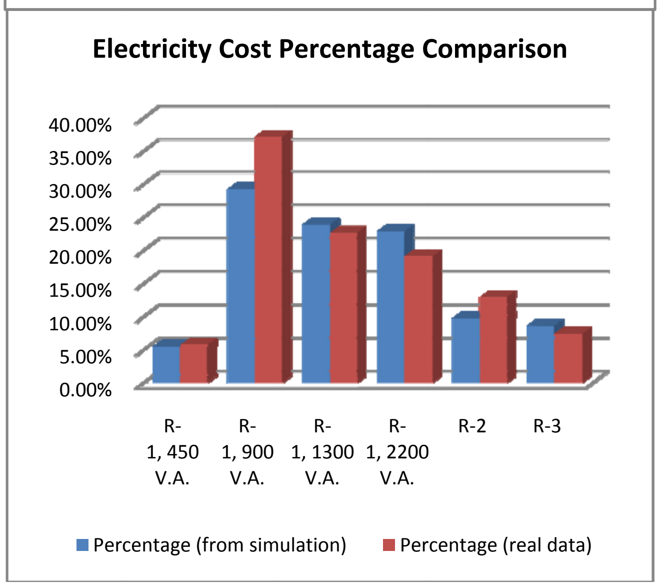


Figure 3 Electricity Consumption And Electricity Cost Comparison

Table 6 Consumption and Cost Per Households Comparison

PLN's households segment	Real Data		Simulation Result	
	Mean Consumption	Mean Cost	Mean Consumption	Mean Cost
R-1, 450 V.A.	156.95	51,372.60	256.37	124,074.31
R-1, 900 V.A.	162.68	92,337.06	402.65	212,914.07
R-1, 1300 V.A.	225.89	166,030.85	562.86	444,660.38
R-1, 2200 V.A.	338.66	254,548.24	975.48	775,503.99
R-2	592.51	504,612.68	1094.39	974,011.35

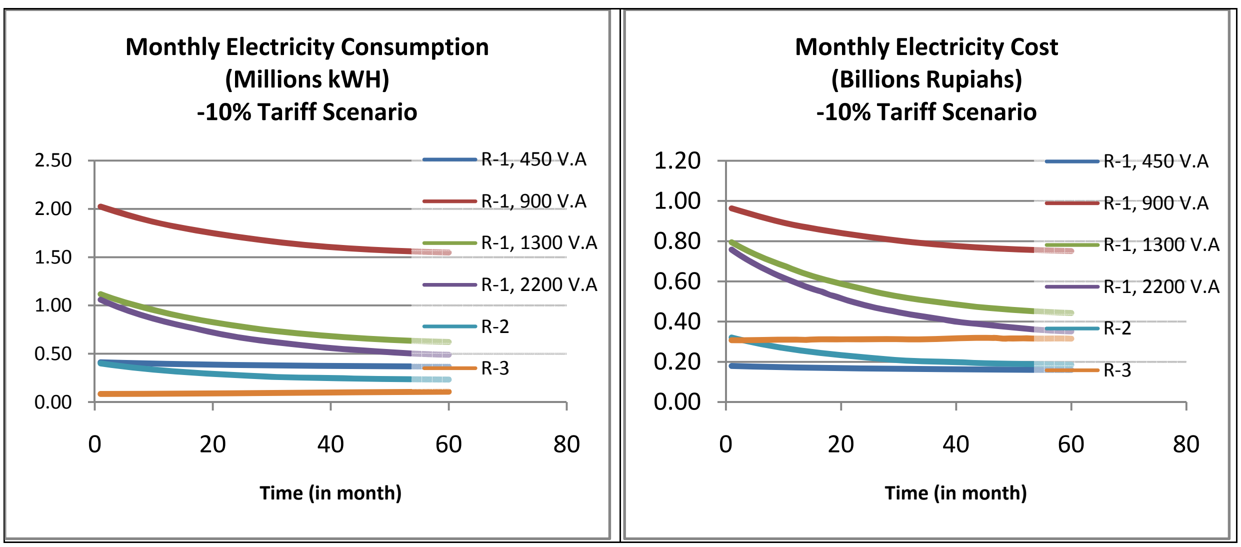
R-3	1,190.73	1,374,610.70	1118.92	4,046,339.50

The result in that shown in Figure 3 and Table 6 was the average of the 30 times simulations run. Even though result of the simulation shows quite different in number, the order from the highest and the lowest mean electricity consumption and mean electricity cost is similar. The difference in the number is mainly caused by the random number generation process when initiating appliances electricity consumption. The data use in generating this number is based on the highest power consumption claimed by the manufacturer, and not based on the real time usage of appliances electricity consumption. Therefore the result shows that the model has the external validity level II.

4.2 Sensitivity Analysis

To check whether the model is sensitive to the change in the parameter, then the sensitivity analysis is conduct. Because this research mainly focuses on the effect of electricity fare to the electricity consumption, this parameter was chosen because it is the parameter that can be controlled by the decision maker. To understand the effect of this tariff to household's electricity consumption, experiment is done under three scenario of tariff. First is with the current tariff scenario, the second is by raising the tariff about 10% and the last is by lowering the tariff about 10% too.

The simulation was run for 60 months or 5 years and the total electricity consumption and total electricity cost for each PLN's market segment for the household segment is to be analyzed. The result can be seen in Figure 4. All scenario was run for about 10 times and tested for its normality, then T-test for equality means is conducted to know whether the difference in the decrease in the electricity consumption and electricity cost are significant. The T-test result in comparing mean difference from current tariff scenario and increased 10% from current tariff scenario can be found in Table 7.



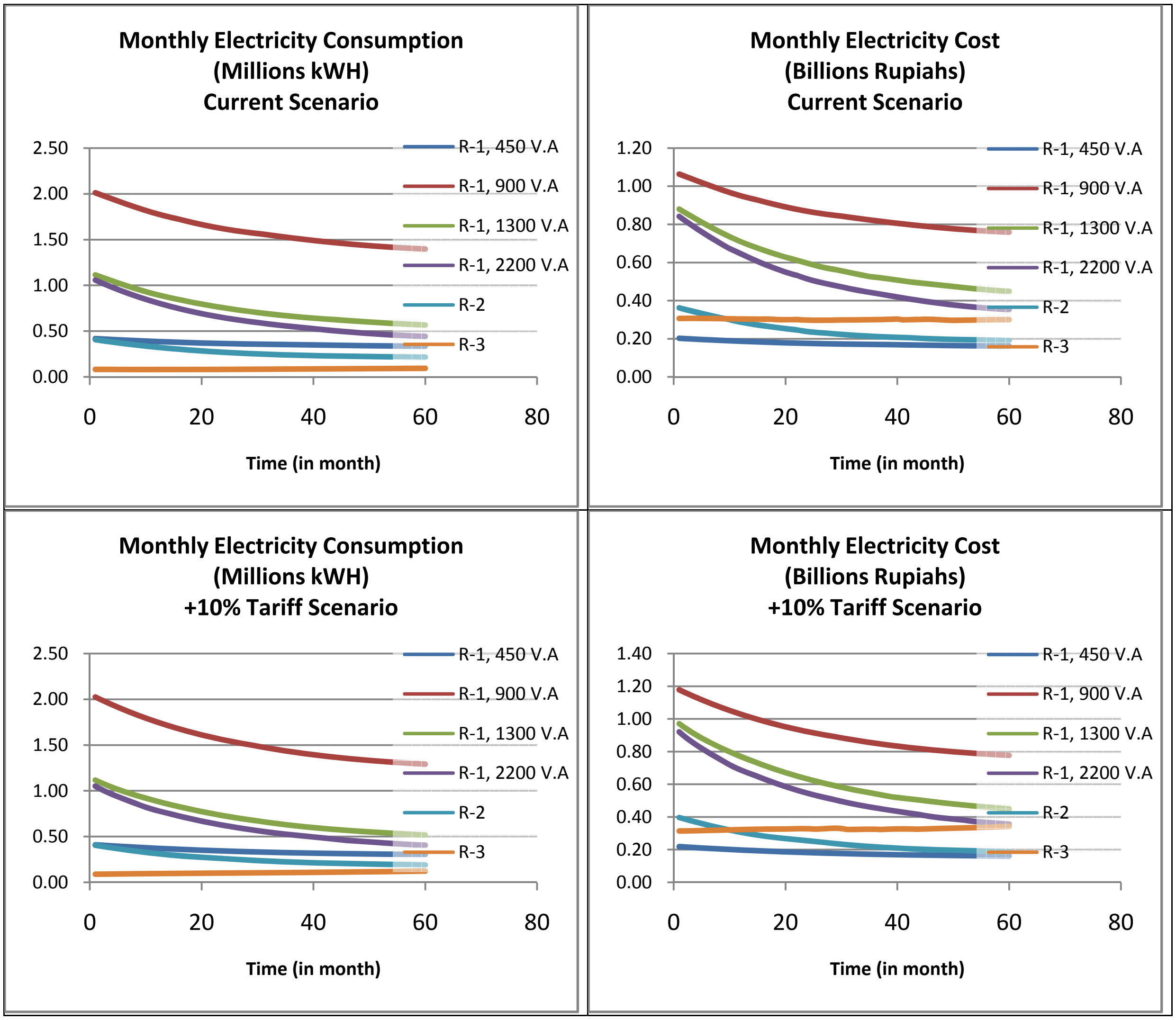


Figure 4 Simulation Result for Three Scenarios in Sensitivity Analysis

Table 7 T-test for Means Equality in Current Tariff Scenario and Increased 10% from Current tariff Scenario

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
CONS_R1_450	Equal variances assumed	.374	.546	13.753	28	.000	22922.03	1666.68
	Equal variances not assumed			13.753	27.930	.000	22922.03	1666.68
CONS_R1_900	Equal variances	.409	.528	26.513	28	.000	109332.05	4123.78

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
	assumed							
	Equal variances not assumed			26.513	26.570	.000	109332.05	4123.78
CONS_R1_1300	Equal variances assumed	.375	.545	23.433	28	.000	44135.50	1883.44
	Equal variances not assumed			23.433	27.388	.000	44135.50	1883.44
CONS_R1_2200	Equal variances assumed	.320	.576	20.258	28	.000	30724.04	1516.61
	Equal variances not assumed			20.258	25.386	.000	30724.04	1516.61
CONS_R2	Equal variances assumed	.455	.505	14.636	28	.000	18930.97	1293.41
	Equal variances not assumed			14.636	27.755	.000	18930.97	1293.41
CONS_R3	Equal variances assumed	.003	.953	-1.673	28	.105	-4359.37	2605.27
	Equal variances not assumed			-1.673	27.899	.105	-4359.37	2605.27
COST_R1_450	Equal variances assumed	.906	.349	-4.183	28	.000	-3606977.74	862328.00
	Equal variances not assumed			-4.183	27.956	.000	-3606977.74	862328.00
COST_R1_900	Equal variances assumed	.079	.781	-7.980	28	.000	-16965226.05	2125989.62
	Equal variances not assumed			-7.980	27.536	.000	-16965226.05	2125989.62
COST_R1_1300	Equal variances assumed	.695	.411	-4.968	28	.000	-7547441.23	1519174.02
	Equal variances not assumed			-4.968	26.601	.000	-7547441.23	1519174.02

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
COST_R1_2200	Equal variances assumed	.521	.476	-7.625	28	.000	-9377215.08	1229810.24
	Equal variances not assumed			-7.625	26.433	.000	-9377215.08	1229810.24
COST_R2	Equal variances assumed	1.400	.247	-.715	28	.480	-842315.23	1177683.90
	Equal variances not assumed			-.715	26.524	.481	-842315.23	1177683.90
COST_R3	Equal variances assumed	.950	.338	-2.294	28	.030	-9585556.37	4179045.86
	Equal variances not assumed			-2.294	27.836	.030	-9585556.37	4179045.86

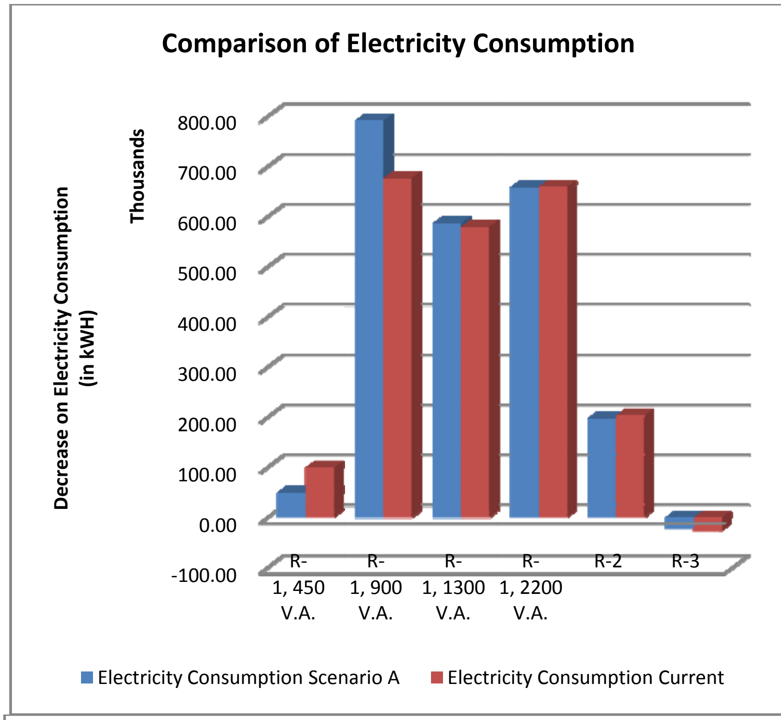
From Table 7 we can see that there is significant difference between the current tariff scenario and increased 10% from current tariff scenario for most of the PLN's households segments. Exception was seen from the R-3 segment, both of the electricity consumption and the electricity cost mean was about the same. This result shows that the R-3 segment was not sensitive to the change in the electricity fare. From the table we can also see the minus sign is the mean difference, which means that the decrease in electricity consumption and electricity cost in increased 10% scenario is bigger that in current tariff scenario. Therefore, by increasing the electricity fare, the electricity consumption in PLN's household segment decreases. The biggest saving in electricity used was happen in the R-1, 900 V.A. segments for the decrease in electricity consumption is about 123.247kWH. Accordingly, similar result also occurred on the decrease in the electricity cost data. The comparison between current tariff scenario and decreased 10% from current tariff scenario also shows similar result with this result.

4.3 Experiment

Previous sections have shown that the agent-based model in this research is valid with level 2 validity and also sensitive to the parameter variation. This section discusses some possible policy scenarios and tests them using this agent-based model.

4.3.1 Scenario A: Tariff without Fixed Cost and Block System

The R-1, 450 V.A. and R-1, 900 V.A. tariff systems consist of fixed cost and block system with different fare per block. In this scenario the fixed cost and block system are eliminated and replaced by flat rate, similar to other segments tariff.



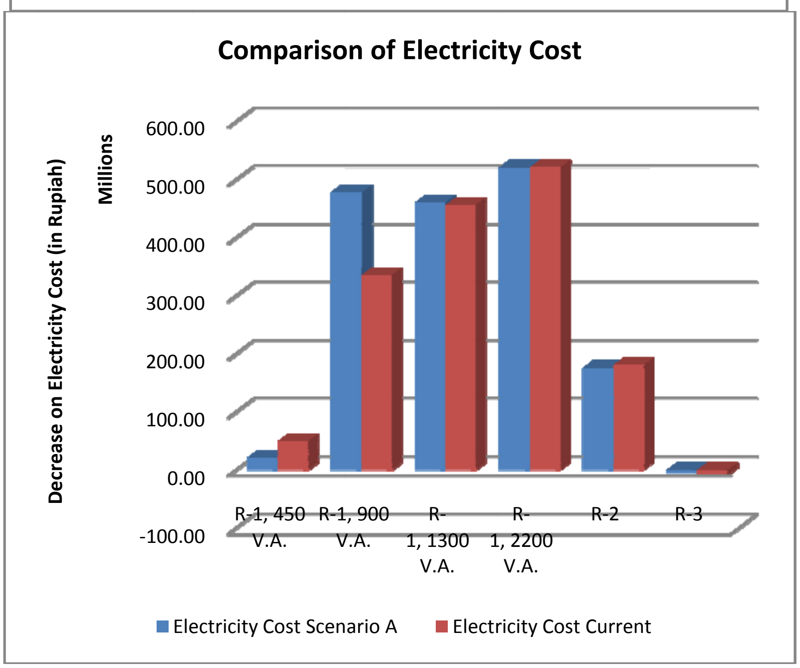


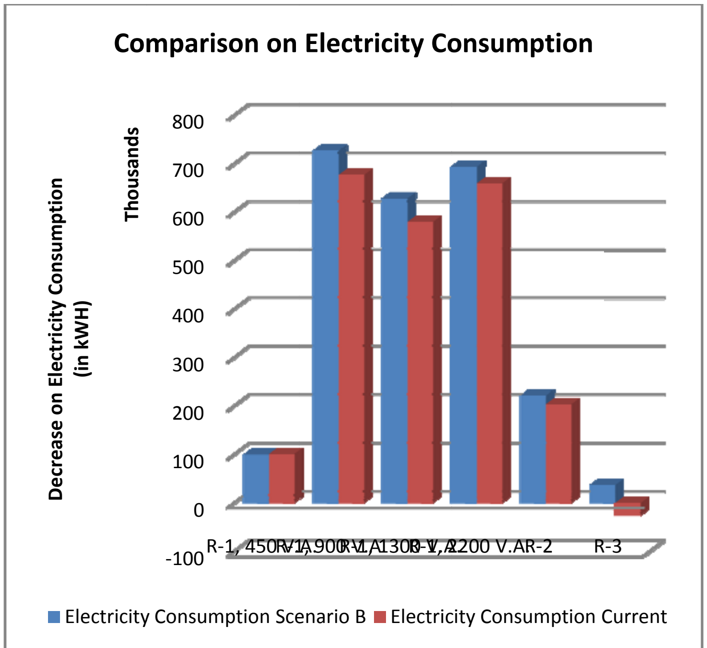
Figure 5 Comparison on the Decrease of the Electricity Consumption and Electricity Cost For Scenario A and Current Tariff Scenario

This scenario is run 5 times and the average of all result is used for further analysis. To understand the effect of this tariff system change, the decrease of electricity consumption under this tariff scenario is compared to the simulation result under current tariff scenario. Both results are described in Figure 5. In both Figures we can see that there is significant decrease on the electricity consumption and electricity cost for the R-1, 900 V.A. segment. Even though the electricity consumption in the R-1, 450 V.A. segment increase, it was compensated by the decrease in the R-1, 900 V.A. segment. Therefore in total, both electricity consumption and electricity cost are decrease when the fixed cost and block system for the R-1, 450 V.A. and R-1, 900 V.A. are replaced by the flat rate system.

4.3.2 Scenario B: Progressive Tariff Scheme

In the second scenario, electricity fare for R-1, 450 V.A. segment is not changed. However, the R-1, 900 V.A. segment's electricity fare is increased by 5%, higher segments electricity fare are increased by 15% and R-3 segment electricity fare is increased by 50%. This scenario was built based on the result of sensitivity analysis in which the R-3 segment was unsensitive while R-1, 900 V.A. is very sensitive to the variation of electricity fare.

Similar with the previous scenario, simulation for this scenario also runs for 5 times. Thus, the mean in the decrease of electricity consumption and electricity cost is used and compare it to the simulation result with current tariff scenario and increased 10% from current tariff scenario. The comparison with current tariff scenario is described in Figure 6. Both figures show that under Scenario B the decrease on the electricity consumption is higher than in the current tariff scenario. This means that there are more efficient uses of electricity when this scenario is applied.



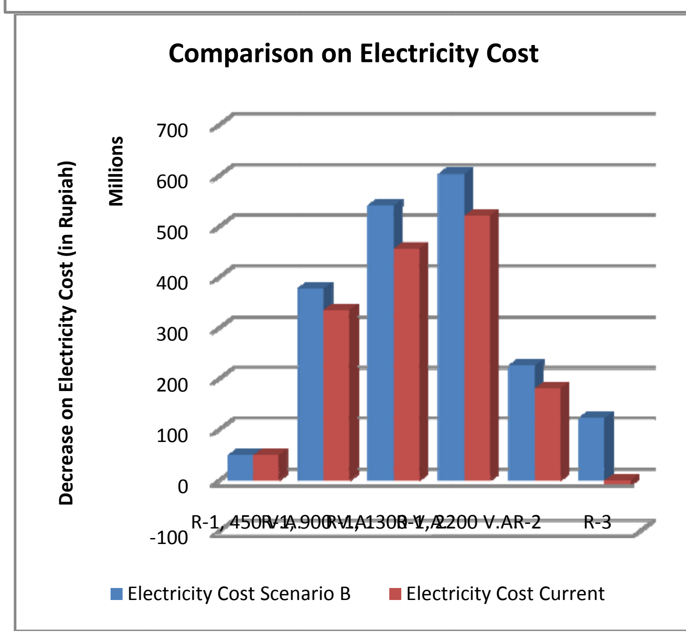


Figure 6 Comparisons in the Decrease of the Electricity Consumption and Electricity Cost for Scenario B and Current Tariff Scenario

5. Conclusions and Further Research

There are several conclusions that we can take from this study. First, This study shows that the result from the agent-based model have a quite similar composition of each PLN's households segment with the real data from PT. PLN (persero) Bandung city branch. The validation Despite of several limitation in the model built in this study, this result can be shows an ability to mimic the real condition of electricity demand in Bandung, especially when it is related to the electricity fare.

The different type of electricity user has different type of appliances and behavior in using electricity in their households. The different ability in paying their electricity bill also affects their behavior. R-1, 450 V.A. segment has the lowest mean electricity consumption and although its total electricity consumption is higher than R-2 and R-3 segments, its total electricity cost is still the lowest since its electricity tariff also the lowest among all segments. The second lowest mean electricity consumption is the R-1, 900 V.A. segment. However, because of its large number of member the total electricity cost become far higher than other segment and the total electricity cost also become the highest among all. When we see as a whole in time span 5 years of the simulation, most of the segments reaction is similar. However, only the R-3 segment tends to react differently from other segment and keep its electricity consumption and electricity cost quite flat.

When the electricity fare is increased, the households tend to lower their electricity consumption, except for the R-3 segment. This segment is very insensitive to change in the electricity fare. Because of the huge number of electricity user in segment R-1, 900 V.A., the increase of electricity fare in this segment can give big impact to the saving of electricity consumption in Bandung city. The next segment that gave quite high saving when the electricity fare was increased is the R-1, 1300 V.A. segment and R-1, 2200 V.A. segment.

To support energy efficiency in Bandung the increase in electricity fare can be used in Bandung city. The big impact in electricity saving is mainly happen if the electricity fare for the R-1, 900 V.A segment is raised, followed by the R-1, 1300 V.A and R-1, 2200 V.A. segment. However, this is cannot be applied to the R-3 segment, since this segment didn't shows any change in their electricity consumption when the electricity fare is changed. However, any combination of electricity tariff component can be change to meet government objectives as well as ensure the electricity efficiency in the households segment. One example of scenario that can be used for the government is the scenario B in the experiment section. This scenario can reduce the state budget (APBN) burden with small impact to the PLN consumers, since the scenario is considering the buying power of each segment in the households segment. However, further research about the possible effect of this scenario when it applied must be done in the decision makin process regarding the implementation of the scenario.

For further development, the model can be incorporating the possibility of migrate from one segment (and electricity capacity) to another segment. The composition of today's PT. PLN (persero) source of electricity is mainly fueled with oil and coal which is inexpensive and generate a high CO2 emission. Incorporating the possible renewable energy source and cheaper energy source to the composition of PT. PLN (persero) power source also can improve the model to understand its effect to the CO2 emission and align it with the PT. PLN (persero) wish to reduce its production cost. The simulation shows that R-3 segment is highly insensitive to price increase, therefore another studies focusing in this segment and investigating how their behavior in using electricity and why this behavior shown by the household can also conducted.

Reference

Abduh, S., Abdullah, C. S., &Zain, A. Y. (2003). Pricing On Electricity Tariff: An Analysis Using Electricity Consumption In Commercial Sector.

Aguilar, S. (2009). Dismantling Fossil Fuel Subsidies? *Environmental Policy and Law, 39/6* ,299.

Aubin, C., Fougere, D., Husson, E., &Ivaldi, M. (1995). Real-Time Pricing Of Electricity ForResidential Customers: Econometric Analysis of An Experiment. Journal of Applied Econometrics (1986-1998), 175-195.

Axelrod, R. (2003). Advancing the Art of Simulation in the Social Sciences.*Japanese Journal for Management Information System, Special Issue on Agent-based Modeling*, 12 (3).

Axtell, R., & Epstein, J. (1994). Agent-Based Modeling: Understanding Our Creations. *The Bulletin of the Santa Fe Institute*, 28-32.

Clough, E. (2007). Strategic Voting Under Conditions of Uncertainty: A Re-Evaluation of Duverger's Law. *British Journal of Political Science, 37*, 313–332.

Druckenmiller, D. A., & Acar, W. (2009). An Agent-Based Collaborative Approach to Graphing Causal Maps for Situation Formulation. *Journal of the Association for Information Systems, Vol. 10 Special Issue 222*, 221-251.

Gilbert, N. (2004, December 18). *Agent-based Social Simulation: Dealing With Complexity.* Retrieved May 2011, 28, fromhttp://www.agsm.unsw.eduau/bobm/teaching/SimSS/ABSS-dealingwithcomplexity-1-1.pdf

Gilbert, N. (2008). *Agent-Based Models.*Los Angeles: SAGE Publications.

Gleerup, M., Larsen, A., Leth-Petersen, S., &Togeby, M. (2010). The Effect of Feedback by Text Message (SMS) and Email on Household Electricity Consumption: Experimenal Evidence. The Energy Journal; 31, 3, 113-123.

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., &Tatham, R. L. (2005).*Multivariate Data Analysis (6th Edition).*New Jersey: Prentice Hall.

Harp, S., Brignone, S., Wollenberg, B., &Samad, T. (2000). SEPIA: a simulator for electricpower industry agents. *IEEE ContrSyst Mag*, 53–69.

Hartmann, S. (1996).The World as a Process.Simulation in the Natural and Social Sciences. InR. Hegselmann, U. Muller, & K. Troitzsch, *Modelling and Simulation in the SocialSciences from the Philosophy of Science Point of View* (pp. 77-100). Dordrecht: Kluwer.

Kahle, L. R., Beatty, S. E., & Homer, P. (1986). Alternative Measurement Approaches toConsumer Values: The List of Values (LOV) and Values and Life Style (VALS). *The Journal of Consumer Research, Vol. 13, No. 3*, 405-409.

Matsukawa, I. (2001). Household Response to Optional Peak-Load Pricing of Electricity.Journal of Regulatory Economics, 249-268.

Möst, D., & Genoese, M. (2009).Market power in the German wholesale electricity market.*The Journal of Energy Markets*, 47-74.

Mukhtasor.(2010, Januari 14).*Menghapus Subsidi Energi, Kebijakan Salah Kaprah*. RetrievedMarch 31, 2010, from Kompas.com:http://bisniskeuangan.kompas.com/read/2010/01/14/17114775/Menghapus.Subsidi.Energi..Kebijakan.Salah.Kaprah.

Nugroho, H. (2005, January). Apakahpersoalannyapadasubsidi BBM?Tinjauan terhadap masalah subsidi BBM, ketergantungan pada minyak bumi, manajemen energy nasional, dan pembangunan infrastruktur energi.*Majalah Perencanaan - BAPPENAS*.

Perspektif Baru. (2002, April 23). *Pencabutan Subsidi BBM Akan Dorong Pemanfaatan Energi Alternatif*. Retrieved March 31, 2010, from PerspektifBaru:

Schwoon, M. (2006). Simulating the adoption of fuel cell vehicles. *Journal of Evolutionary Economics, 16*, 435–472.

Sexton, R. J., Sexton, T. A., Wann, J. J.-W., & Kling, C. L. (1989). The Conservation And Welfare Effects Of Information In A Time-of-Day Pricing Experiment. Land Economics,272-279.

Smith, E. R., & Conrey, F. R. (2007). Agent-Based Modeling: A New Approach for Theory Building in Social Psychology. *Personality and Social Psychology Review, 11 (87)*, 87-104.

The UNEP Division of Technology, Industry and Economics. (2008). *Reforming Energy Subsidies.* Paris: United Nations Environment Programme.

wikipedia. (2010, June 28). *en.wikipedia.org*. Retrieved June 30, 2010, from Electricity market:http://en.wikipedia.org/wiki/Electricity_market

Zhou, Z., & Wai Kin Vicotr Chan, J. H. (2009, June 16). *Agent-Based Simulation of Electricity Markets: A Survey of Tools*. Retrieved August 2010, 8, from http://www.eng.rpi.edu/msec/images/stories/downloads/chan_agent_electricity_review.pdf

BRAZILIAN MICROELECTRONICS SECTOR DYNAMIZATION: TECHNOLOGY STRENGTHENING AND SUSTAINABLE DEVELOPMENT ON PRODUCTION CHAINS

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Abstract
The aim of this paper is to assert management mechanisms to support government policies of science technology and innovation, contributing to the identification, planning, and coordination of short, middle and long term integrated actions involving the government, academy and industry in the national ecosystem of microelectronics in Brazil. Given the current context of Brazilian industrial policies, as well as the National Strategy towards Science, Technology and Innovation planned for the 2012-2015 period, this study presents coordinated actions with a triple helix focus towards a greater technologic density and the sustainable development of the value chains of the electronic industry, focusing on microelectronics. Specifically, the paper addresses a public program called National Micro and Nanoelectronic Systems Institute (INCT NAMITEC), a Brazilian multi-institutional research network created in 2008 by the Science, Technology and Innovation Ministry.

Keywords: microelectronics; organizational ecosystems; collaborative innovation; science technology and innovation policy

CONTRIBUTIONS FROM PORTO DIGITAL TO THE HABITAT'S SOCIO-ECONOMIC DEVELOPMENT

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Abstract
Corporate Social Responsibility (CSR) has become an important point in the competitiveness strategy of companies, because in today's business world it is no longer enough to offer quality and competitive price, one has to be differential. To remain competitive in the marketplace, successful companies are increasingly under pressure to examine the impact of their operations inside and outside their institutional walls, and carefully check the impact of their policies and actions on their staff, customers, community and society as a whole [1]. Therefore, it is essential, according to Michael Porter, to build a single strategy, because "companies usually have an economic strategy and a strategy for social responsibility, when they should have a single strategy only"[2]. Considering the previous paragraph and being a Technology Park responsible for increasing the wealth of the community by promoting a culture of innovation and competitiveness of enterprises and knowledge-based institutions associated with it, Porto Digital Technology Park created its CSR policy in order to encourage companies to increase their competitive potential by adopting actions and sustainable practices. For that was created, as part of the core management of the park, a Center for Corporate Social Responsibility, whose focus is on three areas of action: (i) Inclusion of young vulnerable people in the labor market; (ii) Digital Accessibility, and (iii) Waste Electrical and Electronic Equipment (WEEE).
This paper aims at presenting the creation and goals of the Center for Corporate Social Responsibility of Porto Digital, the actions already taken by the same within each strategic area, the results achieved up to the current date, the proportionate contributions to the environment, its future actions and perspectives, as well as the importance of the connection established through Porto Digital between academia, government and business, which has contributed effectively to the success of the Center for Social Responsibility.

Keywords: Corporate Social Responsibility – CSR, Social Inclusion, Digital Accessibility, Waste electrical and electronic equipment – WEEE Porto Digital

1. Introduction

Corporate Social Responsibility (CSR) has become an important point in the competitiveness strategy of companies, because in today's business world it is no longer enough to offer quality and competitive price, it is important to have a differential. To remain competitive in the marketplace, successful companies are increasingly under pressure to examine the impact of their operations inside and outside their institutional walls, and carefully check the impact of their policies and actions on their staff, customers, community and society as a whole [13].

The notion of sustainability is associated with stability, permanence in time and durability. It starts from the observation that the environmental compensatory or corrective policies that aimed at growth symptoms prejudicial are not enough actions. It is necessary a new approach, in which all nations aim at a kind of development that integrates production with resource conservation and expansion, and that links the goals of giving everyone an adequate livelihood and equitable access to resources [5]. Therefore, it is essential, according to Michael Porter, to build a single strategy, because "companies usually have an economic strategy and a strategy for social responsibility, when they should have a unique strategy only" [7].

Being a Technology Park responsible for increasing the wealth of the community by promoting a culture of innovation and competitiveness of enterprises and knowledge-based institutions associated with it, Porto Digital Technology Park created its CSR policy in order to encourage companies to increase their competitive potential by adopting actions and sustainable practices. For that was created, as part of the core management of the park, a Center for Corporate Social Responsibility, whose focus is on three areas of action: (i) Waste Electrical and Electronic Equipment (WEEE); (ii) Digital Accessibility, and (iii), Inclusion of young vulnerable people in the labor market, as shown in Figure 1. Each one of these three action areas has its importance and particular characteristics that bring relevant contributions for technology environment.

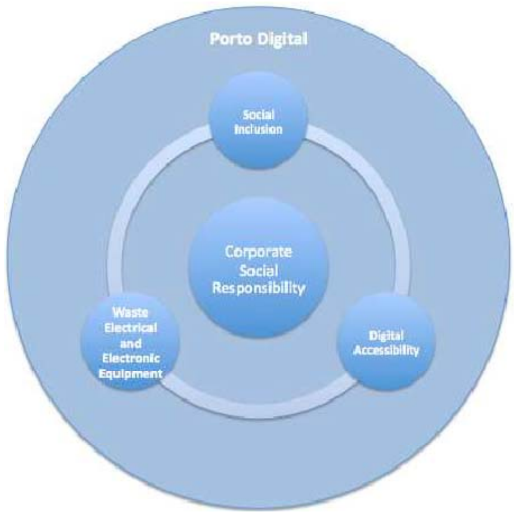

Figure 1: Porto Digital's Corporate Social Responsibility

Thus, this paper aims at presenting creation and goals of the Center for Corporate Social Responsibility of Porto Digital, presenting the results achieved up to the current date and the proportionate contributions to the environment, its future actions and perspectives, as well as the importance of the connection established through Porto Digital between academia, government and business, which has contributed effectively to the success of the Center for Social Responsibility.

This the Center for Corporate Social Responsibility of Porto Digital was structured in a simple way and is viable to be replicated in other innovation environments, particularly in more traditional models of technology parks, usually installed in universities and research centers.

2. The importance of the Sustainability to the Socio-Economic Development

The notion of sustainability is associated with stability, permanence in time and durability. The concept of sustainable development provides a framework for the integration of environmental policies and development strategies [5].

According to [6], Sustainable Development is the development that seeks to meet the needs of the current generation without compromising the future generations to meet their own needs, means enabling people now and in the future, to reach a satisfactory social and economic development level and human and cultural achievement doing at the same time, a resonable use of land resources and preserve the species and the natural habitats.

The United Nations Conference on Environment and Development (UNCED), held from 3 to 14 June 1992 in Rio de Janeiro, known as ECO-92, contextualized sustainability as an effect on the future, by actions done in the present, in other words, "the consequences of economy have an effect on future generations." In the Earth Summit 2002, discussion forum of the United Nations held between August 26 and September 4, 2002 in Johannesburg, South Africa, were conferred three dimensions, which remains the current approach. An economic, social and ecological dimension as illustrated in Figure 2 [7].

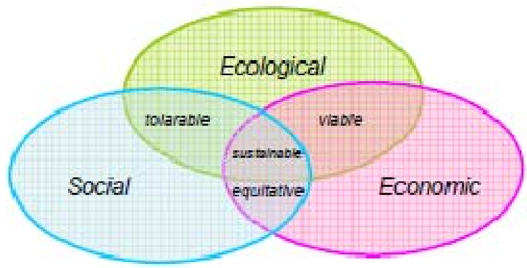

Figure 2 – Representative Scheme of the various components of sustainable development

In this context, sustainability begins to take shape of competitive advantage, interacting with management topics, in order to be organized meaning chains, and not only value chains, in a direction that will ensure the survival and growth of the organization in long-term. Sustainability has enabled this competitive advantage, in a clear innovation and market segmentation in the international context.

This concept is closely related to the Social Responsibility concept of the organizations. Thus, it is essential, according to Michael Porter, to build a single strategy, it states that "companies usually have an economic strategy and a social responsibility strategy, and what they must have is a unique strategy" [7].

A sustainable conscience by organizations might mean a competitive advantage, if considered in first hand as a component of one single organization's strategy, as Porter argues, not as "something" that goes in parallel with the organization strategy, as part of the image or communication policy [7].

3. The role of a Technology Park for a Socio-Economic Development Habitat

As defined by the International Association of Science Parks (IASP), Scientific and Technological Park is an organization whose main goal is to increase the wealth of the community by promoting the innovation culture and competitiveness of enterprises and institutions based on its knowledge. To achieve these objectives, a Science and Technology Park stimulates and manages the flow of knowledge and technologies between universities, research institutions and development - R & D, companies and markets, facilitates the creation and growth of enterprises based on innovation by incubating and spinoff processes, and provides other value-added services and support services of high quality [8].

A Technology park can use its articulation power with other players to build parterships, like for example the state level, that can be also interested in provide social actions that can contribute to a socio-economic development habitat.

Being a Technology Park a relevant asset in the production and consumption of ICT, this is characterized as a potential agent to contribute to the sustainable management of ICT, which may encourage the adoption of best management practices of technological equipment (purchase and use) and their wastes (proper disposal), directly impacting the levels of competitiveness of companies in domestic and foreign markets.

The adoption of the sustainable development concept in a scientific and technological park policy can serve as an attraction to partners and customers, and also as a model to be followed by companies in an innovative and competitive market, since the parks are strategic actors influencing this market.

4. Porto Digital

The main "hotbed" of knowledge and development of ICT applications in Pernambuco is Porto Digital (PD), a Technology Park located in Recife, Pernambuco, Brazil. PD is the result of an innovation environment in Pernambuco which was consolidated in recent decades along with the coordinated effort of the university, the productive sector and the government, in order to insert the industry of ICT in the economic matrix of the State. Sector of high growth potential, ICT is also the basis for increasing the competitiveness of a region.

Porto Digital is the main component of ICT in Pernambuco. Its goal is to implement public policies for the development of the State, urban regeneration, social inclusion, strengthening of the ICT pole and other poles through the use of these technologies. With 12 years of existence, PD is a leading technology pole of the country. PD has generated for the state more than 6.000 jobs, attracted 500 entrepreneurs and 191 institutions among universities, government agency, research centers and development and technology companies with national and international levels. Companies of all sizes have already been installed in PD and are producing new solutions and new technology products.

As a result of the success of all its actions, PD was elected by AT Kearney [9], one of the largest consulting companies in the world, as the largest technology park in the country in number of companies and sales in 2005. In 2007, PD was recognized as the Best Technology Park and Habitat for Innovation in Brazil by the National Association of Entities Promoting Innovative Enterprises, ANPROTEC [10], which represents the interests of business incubators, technology parks and innovative enterprises in Brazil. The recognition came with the National Award for Innovative Entrepreneurship in 2007. Moreover, in 2008, Porto Digital was the only Brazilian technological park to join the first edition of Learning by Sharing from IASP (International Association of the Science Parks) that featured four parks around the world. In 2009, the Business Week, the largest business magazine in the world, noted PD as one of the places where the future was being created. And in 2011, PD was recognized again as the Best Technology Park and Habitat for Innovation in Brazil by the National Association of Entities Promoting Innovative Enterprises, ANPROTEC [10].

To manage the park, it was created in 2001 the NGPD – Management Unit of Porto Digital, a social, private and nonprofit organization. This organization has a role in the success of Porto Digital. NGPD is the agent for implementation of public policies to promote the structure and evolution of the Technology Park, through the implementation of public and private resources. Their actions are guided by a Strategic Plan, whose essence is to strengthen the competitive capacity of companies to enable them to access the regional, national and international markets in another level of scale and magnitude. This strategy involves actions that are related to the six actions axis of the park, as illustrated in Figure 3: Axis 1 Strengthening of Productive and Competitive Capacity of Porto Digital Enterprises; Axis 2 - Integrating Porto Digital with other Economic Sectors of the State; Axis 3 – Stimulation of Specific Industries Intensive in IT Applicants, in particular, the Creative Economy; Axis 4 Strengthening the Image and Institutional Promotion of the PD; Axis 5 - Promoting Social Responsibility actions and Digital Inclusion; and Axis 6 - Strengthening the institutional and governance of PD.

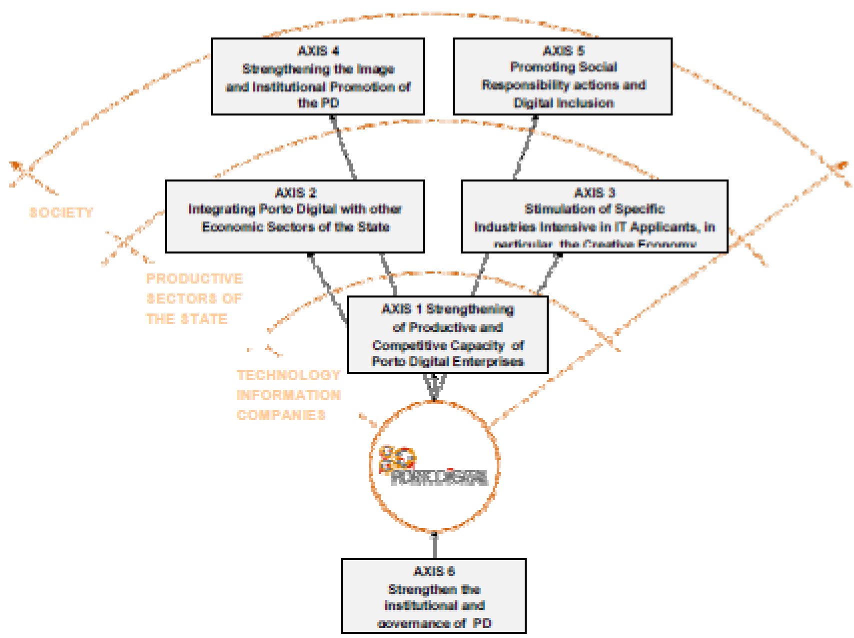

Figure 3 - Porto Digital Action Axis

NGPD main objective is to increase the positive environmental factors (externalities) in order to improve the innovative capacity and competitiveness of enterprises and of the cluster as a whole. To do this, its main roles are: (i) to generate original ideas, (ii) to develop innovative projects, from original ideas, (iii) to joint operating agents, so that projects can be implemented including sponsors, government, enterprises, universities, and (iv) to attract innovative ICTbased companies.

Given the above, it is understood that PD is a valuable asset of Pernambuco state, with the potential to contribute to improve standards of production efficiency in the sector and therefore to improve levels of competitiveness in domestic and foreign markets.

This view gains strength and foundation on the current market situation, where companies need competitive advantages to stand out and excel facing a strained market. Thus, given the constant need to increase the competitive potential of enterprises and the global concern to the sustainability, NGPD created the Center for Corporate Social Responsibility of Porto Digital, in order to help the park to become stronger as a Socio-Economic Development Habitat. In this context, it is noticed the importance of Porto Digital for the economic, ecological and social development, not just for the ICT cluster, but for Pernambuco State. One of its various roles is to work in disseminating knowledge and promoting an sustainable culture.

5. The Center for Corporate Social Responsibility

Porto Digital Technology Park created its CSR (Corporate Social Responsibility) policy in order to help companies to increase their competitive potential by adopting actions and sustainable practices. As part of the core management of the park, the Center for Corporate Social Responsibility was created in 2011 and has its focus on three actions areas: (i) Waste Electrical and Electronic Equipment (WEEE), (ii) Digital Accessibility and (iii) Inclusion of young vulnerable people in the labor market. The next sections will present an overview about each action area, their objectives, how they work and their results.

5.1. Waste Electrical and Electronic Equipment

Overview

Despite of generating numerous benefits to society and of being synonymous of economic and social prosperity, the ICT industry has encouraged excessive consumption of technological equipment and, consequently, the almost compulsory practice of disposal of this material. From this new reality, raises a new environmental challenge: the electronic waste. The life cycle of such equipment is getting shorter, given the technological evolution of recent decades. Thus, the use, treatment and disposal of waste electrical and electronic equipment have become a global concern.

According to UN data [2], between 20 and 50 million new tons of electronic waste are thrown away each year worldwide. It is estimated that this number will triple in the next five years. In Brazil, the installed base of computers increases each year, as reported in the 23 Annual Survey of Use of Information Technology (IT) carried out by Fundação Getúlio Vargas [3]: in 2008 there were 50 million computers in use in Brazil; in 2009, 64 million; in 2011, 85 million, and it is expected that in 2012 will reach 99 million and in 2014 the installed base will be 140 million computers. That is, from 2008 to 2011 there was a 70% increase in the installed base of computers in Brazil, while from 2012 to 2014 growth is estimated at around 42%, totaling an increase of approximately 180% in six years.

Data from the Industries Federation of the State of Pernambuco (FIEPE) [4] estimate that the number of computers in use in 2010 was 1.728 million units in Pernambuco. The number of disposal for the same year was estimated at 345.600 units (20% of installed base),considering an average weight of 10kg on a PC, the disposal of such equipment would have generated a total of 3,456 tons of garbage in the year 2010.

Each year the volume of this type of garbage grows intensively - in Europe, WEEE grow at a rate three times higher than the urban waste [1] - and the environmentally correct ways to dispose them are little known and more complex than the destination of urban trash. The dissemination of good practices and the strengthening of a culture of environmentally sound treatment of these wastes are key points in the environmental agenda of every developed or developing nation directly related to the volume and intensity of its production technology.

Being a Technology Park a large producer and consumer of ICT, this presents itself as a potential agent to contribute to the sustainable management of ICT. Given the outlook presented and considering that the Porto Digital Technology Park directly employs over 6,000 people in the ICT sector in Pernambuco, it has the potencial to contribute to the social and digital inclusion, and sustainable management of WEEE.

For this Porto Digital created the Center of Electrical and Electronic Waste Management, also called ItGreen, to act as part of the Center for Corporate Social Responsibility, being one of its three action areas.

Objectives

The ItGreen consists of a reference center for studies and research, social mobilization and articulation of strategic actors in the life cycle of ICT equipment. It was designed to act as a mechanism through which PD must provide its contributions to the development of a Habitat for Sustainable Innovation.

ItGreen acts as a channel of the Park to support the development of its companies through encouraging the adoption of sustainable practices, which can serve as a competitive advantage for the company and to increase the competitive potential of the park, making it a global showcase of a Socio-Economic Technological Habitat.

ItGreen operates with activities that enable to:

(i) Act in promoting an IT sustainable culture and reuse (metarecycling) and recycling of technology equipment actions, aimed at reducing the environmental impact;
(ii) Structure (and keep updated) a database (on the technological equipment life cycle, management and waste treatment) and reference of relevant actors in the chain;
(iii) Articulate the formation of a social network to promote the sustainable management of waste, with the participation of companies, governments, social organizations linked to social and environmental sustainability;
(iv) Produce and disseminate information to the network and stimulate its functioning through the articulation and promotion of events;
(v) Act in the promotion of social consciousness about the issue of consumption and disposal of electronic equipment in the world, in Brazil and in the State;
(vi) Contribute to the promotion of public policies and the adequacy of the companies to those policies.

How it works

The ItGreen was involved in 2 activities phases: consolidation and operation, as detailed in [14]. The consolidation phase's activities were done in order to enable the acquisition of technical knowledge about the ICT industry and the problem of waste electrical and electronic equipment to structure a solid knowledge base and provide subsidies for the operation of ItGreen.

The ItGreen Operation phase's activities focus on: (i) promoting the discussion of the problem of WEEE among the common society, experts and practitioners; (ii) encouraging and nurture a network of strategic actors; and (iii) promoting the strengthening of the solid waste national public policy (PNRS).

Results

The first phase had the following results:

Creation of the Survey of WEEE Good Management Practices – This activity, directly associated with one of ItGreen goals (ii. designing a database on the management and treatment of its WEEE), aimed to make an analysis of national and international benchmarking on best management practices in WEEE in order to facilitate the use of practices that best fit the reality of companies installed in the park and therefore add value to products and services and gain competitive advantages.

Throughout the survey it was possible to identify the regulatory framework (legal and normative aspects) of electronic equipment production and management of their waste as well as the management practices of leading manufacturers, retailers and recycling units that are in conformity with the prevailing laws and policies and to sustainability standards.

It was noticed that although there are still a few businesses that have adopted good practices in the WEEE management process throughout the life cycle of electronic products manufactured manufactured, marketed and / or recycled, society has increasingly demanded and valued organizational management changes towards more sustainable practices.

Mapping the Life Cycle of Electronics Equipment - Mapping the life cycle of electronic equipment has the aim of meeting the following goal of ItGreen: (ii) designing a database on the life cycle of technological equipment. To achieve this aim a research was done in order to gain a broad perspective of the production chain of the technological equipment (extraction, production, consumption, use, maintenance, reuse, recycling), through statistical data that represent the economic, environmental and social generated at each stage of the life cycle of equipment. This information is important because through the knowledge of the stages of the life cycle of electronic equipment and the impacts generated at each step, it is possible to establish the actions of the Centre for a more strategic and of higher impact on society.

As a result of this activity it was generated a document called Life Cycle Diagnostic Equipment Technology that provides information about the social, environmental and economic impacts generated by each phase of the life cycle of technological equipment.

Registration of Strategic Actors - With the objective of articulate the formation of a social network to promote the sustainable management of WEEE through the exchange of knowledge and the strengthening of existing environmental public policies, a survey was done as well as a registration of strategic actors in the life cycle of electronic equipment represented by government agencies, universities, research centers, manufacturers, companies that use technological equipment, collector cooperatives and experiences of successful management of regional WEEE (PE), national and international level that could serve as a benchmark for the performance of ItGreen and companies in the Porto Digital.

This survey allowed abroad network of stakeholders (manufacturers, retailers, consumers) and experts (decision makers and decision-makers). The register is intended to serve as a reference of key actors in the chain, from which you can identify which institutions provide services for WEEE collection and treatment, or research and development, for example, in a given city in Brazil and abroad. This information can facilitate the creation of environmental policies to be adopted by the Park.

Survey of Porto Digital companies about Management Practices - This activity aimed to identify the characteristics and management practices in IT companies in Porto Digital, to gather information that would support the next activities. For this purpose, an electronic questionnaire survey was elaborated to be filled in online by corporate managers.

The survey results led to the conclusion that the Green IT practices of the companies interviewed are directly linked to reduced use of electricity, namely cost savings, which reflect positively on the environment, economy and society.

The research enabled diagnosing that although 84% of companies are aware of the environmental, social and economic impact from the production / consumption of electronic equipment resulting from the incorrect disposal, only 5% of the companies representatives said they knew any environmental legislation. It was also found that only 37% of companies surveyed reported having a policy and / or procedure for the management of technological waste consumed by the company.

The data from the survey reflects on the little investment in research on Green IT by companies in regard to design, software, computer systems, etc. It also served as the basis for conducting the next activities related to the next stage: the operation.

The second phase had the following results:

Exhibition "History of Computers" - This action was designed to operate in the promotion of social awareness about the issue of consumption and disposal of electronic equipment. The exhibition titled "History of Computers" lasted twenty days and was held from February the 4th till February the 24th of 2011 in Paço Alfândega Mall, located in Bairro do Recife, where Porto Digital lies, exposing parts of the Computer Museum of São Paulo and portraying the history of computers by using old and new parts. The event attempted to sensitize the visitors by sampling sequential pieces which, in a short period, have changed several times in size, model and Technology, on the high consumption needs of the parts due to such changes and, therefore, on their discard. The event attracted nearly ten thousand participants, among visitors to the Mall, groups of public school students, and people interested in information technology.

Donation Campaign / Disposal of WEEE - This action of social mobilization also aimed to act in the promotion of social awareness about the issue of consumption and disposal of electronic equipment and it occurred in parallel with the exhibition "History of Computers", taking place in the same location during the same period. The campaign drew attention to the importance of properly disposing the waste of electrical and electronic equipment and to the benefit of donating equipment which are still in working condition, encouraging digital inclusion and metarecycling. The action collected 349 parts and components of WEEE, the most significant: 54 CPUs, 44 printers, 42 keyboards, 40 monitors, 23 motherboards, 18 daughter boards, 09 handsets, 16 speakers, 15 CD drives, 10 stabilizers, and others.

The collection and disposal of the received equipment during the campaign were conducted by the Center for Computer Reconditioning of Recife, a local partner who was responsible for refurbishing and routing to subsequent donation and the recycling destination. Due to the success of the event and understanding the importance of providing a disposal site and destination of WEEE to Recife's society, the Paço Alfândega mall directors released an area, inside the mall, to receive WEEE material as a way of continuing action and to establish the beginning of a partnership, associated with education and social awareness.

Promoting Workshops - Three workshops were promoted between the 18th and 22nd of February 2011, in order to: (i) promote knowledge exchange and practices with regard to waste management technology, (ii) provide the articulation of a network of waste treatment, (iii) promote a culture of reuse and actions of technological equipment (metarecycling) and recycling of such equipment, and (iv) contribute to the promotion of public policies (national) related to the sustainable management of WEEE.

The workshops targeted representatives of the public (government), private (managers) and academic (professors, researchers and students) sectors who work in the environmental area in Pernambuco. Each workshop had a workload of 08 hours, and discussed themes based on the ItGreen's consolidation actions:

• Articulation of Strategic Actors of the Value Chain of the Electrical and Electronic Equipment
• Practice for the Disposal of Waste of technology Equipment;
• Value Chain of Technology Equipment

The realization of International Seminar on Waste of Electrical and Electronic Equipment (SIREE) - The realization of SIREE 2011 conference was a success. The seminar addressed the issues related to legal and normative mechanisms developed in the country and abroad, issues related to the life cycle of equipment, players involved in their management and import / export waste technology, providing the approach of the local public with national and international audience, sharing knowledge and specific experiences and promoting discussion between speakers and participants.

In addition to that the seminar had a different goal: to produce a "Carta Recife" a paper with the summary of the debates held during the panels of the event through the participation of about forty guests, among lecturers, managers of public and private institutions, representatives of academia and society, all participants of the seminar.

The "Carta Recife - Document of Contributions to the Planning and Management of WEEE" contained action, responsibilities and challenges to be undertaken for an effective management of WEEE in the country. The document considered the effectiveness of the proposed content of the national Law 12.305/2010 [11] and Decree 7.404/2010 [12], about the preparation of Solid Waste Management Plan.

This document was sent to the Ministry of Environment (MMA) in order to contribute as a subsidy to make decisions about the National Solid Waste (under jurisdiction of the Interministerial Committee of the National Policy of Solid Waste) and the model of reverse logistics system (under jurisdiction of the Steering Committee for the Implementation of reverse Logistics Systems).

In June 2011, Porto Digital was invited to formally present the "Carta Recife" at the 3rd Meeting of the Thematic Working Group of Waste of Electrical and Electronic Equipment (GTT-REEE) of the Committee for the Implementation of the System of Reverse Logistics, coordinated by the Ministry of Development, Industry and Foreign Trade - MDIC, in Brasilia, where it was possible to present the results generated so far by ItGreen and expose its contributions on the issue.

The workshops and the Seminar gathered a total audience of about 300 people, of which 65% originated from Pernambuco, 31% of other states of Brazil and 4% from abroad.

Both the participating public and the local and national media have recognized the importance of holding an event with the magnitude of SIREE in Recife, with an explicit statement of interest by all in holding a second edition of SIREE in Recife in 2012. Also in Brasilia, during the meeting of GTT-REEE, there was incentive for a second edition, in 2012, and the interest of some of the participants to speak at the event, thereby contributing to the generation of an active network.

Elaboration of the Good Practice Guide for Sustainable IT Management - This Guide was developed targeting the needs of companies in the park, and it was intended to serve as a consultation tool for entrepreneurs and managers, in particular for companies in the Porto Digital, but it can be also be used by ordinary citizens.

The Good Practice Guide for Sustainable IT Management presents sustainable IT practices in form of recommendations on what to do and how to do it going beyond the reduction of energy consumption during the use of electronic equipment. Some green IT practices discussed in the Guide are: virtualization of servers and desktop, use of videoconferencing for meetings, saving paper and the correct disposal of electronic equipment (donation and recycling).

Elaboration of a Replicability Manual - ItGreen was structured in a simple way and is viable to be replicated in other innovation environments, particularly in more traditional models of technology parks, usually installed in universities and research centres. Thus, understanding the importance of ItGreen as a mechanism for sustainability of the innovation and socioeconomic environment of Porto Digital and believing in the viability of promoting the replication of other parks, was prepared a "Manual for Replication Centre", which in turn is a product to be consumed by other Brazilian Parks, demonstrating the viability of replicating the idea in other parks of innovation with a focus on promoting sustainability.

5.2. Digital Accessibility

Overview

In recent years, technological innovation in information and communication management has provided socioeconomic growth and the improvement of people's lives in many ways. The social inclusion of socially and economically disadvantaged and with special needs people, through digital inclusion, is an example of the importance of Information and Communication Technology (ICT) in building a fairer and egalitarian society.

The digital inclusion, seen as a process that will enable disadvantaged people opportunities to share the economic, social, political and cultural benefits produced in contemporary society, is a form of social inclusion through the use of ICT. Thus, the ICT industry can facilitate the inclusion of disadvantaged people in the labor market in order to improve their quality of life, stimulate income generation as well as to stimulate the growth of the ICT industry itself.

In today's information society, the ICT industry has also allowed many people with special needs to participate more actively in society. Through ICT it is possible for people with special needs to transpose their limitations and to relate more broadly with society, especially through the Internet. Thus, the ICT sector is one that can more easily absorb people with disabilities in their staff, since their production model is based exclusively on intellectual production and makes it possible for its users to overcome their limitations due to disability, even in the midst of a work activity. For that it is enough to use tools adapted to the specific need of the person, as long as he/she has the adequate knowledge and technical competence.
To encourage digital accessibility, Porto Digital has taken it as one of the action areas of the Center for Corporate Social Responsibility.

Objectives

The objective of the Digital Accessibility area is: (i) to raise awareness about digital accessibility; (ii) to stimulate the discussion over accessible technologies; (iii) to promote the use of good practices of digital accessibility; (iv) to create a culture around the digital accessibility subject.

How it works

To achieve its objectives this area has in its core the following activities:

- Hosting Seminars about Digital Accessibility – Once in a year Porto Digital tries to realize a national seminar to discuss about new technologies, good practices, new tools, and create a network to change ideas and stimulate the culture in the environment.
- Conducting research and studies – Porto Digital is always investing in studies and researches about new technologies, good practices adopted by companies and academy in the country and in the world and government guidelines in order to guide the next steps to be performed by the Center for Corporate Social Responsibility;
- Conducting training courses for programmers assistive technologies – Along the year the idea is to conduct several training courses in order to disseminate the knowledge about accessibility to the employees of the park;
- Articulation of strategic actors – Strategic actors in this chain should be identified with 2 purposes: the first is to know who are the experts that is exercising some work in that area. It is important to try to involve them on the center’s activities. The second purpose is to try to know who are the actors that can have common interest in digital accessibility area to try to make some partnerships, attract resources to put in practice some actions, etc.

Results

Since the creation of the CSR Policy, Porto Digital has acted actions and in order to change this reality and to contribute to social inclusion of young people in situation of vulnerability to the labor market. This way, Porto Digital has become a partner in the project "Young Women in Action" (JMA). The JMA project is a partnership between the Nike Foundation and the U.S. Academy for Educational Development (ADE), which intends to benefit 1.000 young women to enter the labor market throughout 3.5 years. Porto Digital supported the last cycle of the program (there were 5 cycles) and contributed to qualifying 60 young women. It was offered the infrastructure and provided 3 project managers volunteering for mentoring the youngsters. It has also provided the HP LIFE training for 15 students, out of the 60. The expectation is to extend the partnership and continuing providing training for young people.

In partnership with Ministry of Science, Technology and Innovation (MCTI), Porto Digital is building a program to be implemented in public schools. The program should introduce the young students from the high school level to a program language knowledge in order to training them to be absolved by the marketing.

Porto Digital has two professional that are qualified by Hewlet Packard (HP) to provide training to a wide range of people’s profile on HP Learning Initiative for Entrepreneurs (HP LIFE), a program that enhances IT as a tool for business growth. Besides the qualified professionals This facility is then offered to join in already existent social projects or to execute basic projects to the community.

6. Conclusion

In only one year of existence the Center for Corporate Social Responsibility from Porto Digital has achieved a series of interesting results in each one of its three areas: (i) Waste Electrical and Electronic Equipment (WEEE); (ii) Digital Accessibility, and (iii), Inclusion of young vulnerable people in the labor market.

The results of the Center were directly related to the triple helix concept, involving the academia, through the researches done by their experts and their presenters in the seminars; the government through the partnerships established and the companies through the courses and seminars offered to their employees and the manuals of good practices produced to oriented the companies about the Cooperate and Social Responsibility.

The operationalization of the Center for Corporate Social Responsibility by NGPD is also within three (03) of the six (06) axis of action of the park. Axe 1 “Strengthening the Productive and Competitive Capacity of PD Enterprises”, as the Centre intends to encourage companies to adopt the park Corporate Social Responsibility practices, by promoting actions of shared responsibility in social responsibilities. In this context, by adopting such practices, companies can use them as part of their competitive strategy, aiming at the survival and growth of the organization in the long run. Thus, NGPD contributes to strengthening the competitiveness of companies in Porto Digital. Axe 4 “Strengthening the Institutional Image and the Promotion of PD”, as the contributions provided by the Centre can provide the companies not only an increased competitive advantage, but also an excellent tool to promote the company’s image in the community and consumers since corporate and social actions are on global debate and are well appreciated by consumers. Axe 5 “Promote Social Responsibility Actions and Digital Inclusion”, as many of the activities performed by the center are characterized as acts of Social Responsibility, such as: conducting seminars and workshops to discuss among the strategic actors of the chain issues related to sustainable policy, the publication of materials designed to encourage the adoption of best management practices for sustainable businesses, among others. Moreover, such actions are intended to encourage companies to adopt, as part of their strategies, other actions related to CSR, such as using the manual of good practices of sustainable IT management and the manual of good practices of digital accessibility created by the Centre; to participate and support such events, among others.

The Center for Corporate Social Responsibility presents a model of sustainable management of ICT that can be easily replicated anywhere in the world. The performance model gives special attention to conducting research studies, as well as the articulation of a network of actors who must be fed into discussions involving the market and public policy solutions to the impacts generated by ICT. It also has the potential to encourage the adoption of corporate and social practices by society in general.

The Center intends to continue its actions through: (i) the creation of a website for the Centre, which should serve as a tool to articulate and supply social network of communication, with news release, access to institutional publications and to document database, to the registration of strategic actors, to the good practice guides, etc..; (ii) the promotion of the second edition of the SIREE and of the Digital Accessibility Seminar, which aims to feed the network of strategic actors and disseminate new practices and technologies; (iii) the definition of indicators for monitoring progress and the change of corporate behavior in relation to sustainable IT practices, deepening and updating the business Survey of Porto Digital; (iv) the dissemination of research results and studies, the promotion of the seminar for business entrepreneurs of Porto Digital, which will be encouraged to adopt the guides of good practices produced and to use the "Register of strategic actors" as a tool in conjunction with the strategic actors of the network.

The knowledge dissemination, social mobilization and articulation of strategic actors provided by the actions of the Center besides being an input to promote integrated management and social awareness and to ensure the involvement of ICT entrepreneurs and society as a whole, also promotes the reduction of the gap between business and society in an act of shared responsibility.

It is believed therefore that the promotion of the corporate and social responsible actions, especially related to technology, are of fundamental importance in the institutional image of the technology environment of a region, serving as a benchmarking example for other parks in the country and improving access of Brazilian technology to international markets.

References

[1] UNITED NATIONS ENVIRONMENT PROGAMME – UNEP. *Ewaste Volume I*: Inventory Assessment Manual. 2007. Available at: <http://www.unep.or.jp/Ietc/Publications/spc/EWasteManual_Vol1.pdf>. Access on September 2010.

[2] UNITED NATIONS ENVIRONMENT PROGAMME – UNEP. *E-waste*: the hidden side of IT equipment's manufacturing and use. 2005. Available at: <http://www.grid.unep.ch/product/publication/download/ew_ewaste.en.pdf>. Access on July 2010.

[3] FGV/EAESP-SP. *21ª Pesquisa Anual do Uso de TI*. São Paulo, 2010. Available at: <http://www.scribd.com/doc/30187399/FGV-GVcia-21%C2%AA-Pesquisa-Anual-2010- Administracao-de-Recursos-de-Informatica>. Access on September 2010.

[4] FEDERAÇÃO DAS INDÚSTRIAS DO ESTADO DE PERNAMBUCO – FIEPE. Conselho temático de meio ambiente. In: Seminário Internacional sobre Resíduos de Equipamentos Eletroeletrônicos (SIREE),1, 2011, Recife. Available at: <http://siree.portodigital.org/downloads/apresentacoes/anisio_coelho.pdf>. Access on February 2011.

[5] MOISÉS, H. O Município-Rede - Planejamento, desenvolvimento político e sustentabilidade. In: *O município no século XXI*: cenários e perspectivas. São Paulo: FPFL/CEPAM, 1999. p. 305-324.

[6] DESENVOLVIMENTO Sustentável. Available at: <http://www.cmamadora.pt/PageGen.aspx?WMCM_PaginaId=42786>. Access on July 2011.

[7] SUSTENTABILIDADE Econômica. Available at: <http://pt.wikipedia.org/wiki/Sustentabilidade_econ%C3%B3mica>. Access on July 2011.

[8] MIRANDA, Z. A. I. & NEGREIROS, R. Parque Científico e Tecnológico como mecanismo indutor de desenvolvimento sustentável. *Revista de Gestão Integrada em Saúde do Trabalho e Meio Ambiente*, São Paulo, v.2, n.4, 2007. Available at: <http://www.interfacehs.sp.senac.br/index.php/ITF/article/viewFile/141/163> Access on July 2011.

[9] AT KEARNEY. Desenvolvimento de uma Agenda Estratégica para o Setor de "IT Offshore Outsourcing". Brasília, 2005.

[10] ASSOCIAÇÃO NACIONAL DE ENTIDADES PROMOTORAS DE EMPREENDIMENTOS INOVADORES. Panorama de Incubadora de Empresas e Parques Tecnológicos 2006. Brasília> ANPROTEC, 2005. Available at: <http://www.anprotec.org.br/ArquivosDin/Panorama_2005_pdf_11.pdf> Access on July 2011.

[11] BRASIL. *Lei No. 12.305*. Brasília, 2010. Available at: <http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2010/lei/l12305.htm> Access on September 2010.

[12] BRASIL. *Decreto No 7.404*. Brasília, 2010. Available at: <http://www.planalto.gov.br/ccivil_03/_Ato2007-2010/2010/Decreto/D7404.htm> Access on September 2010.

[13] BORGES, F. G. *Responsabilidade Social: Efeitos da Atuação Social na Dinâmica Empresarial*. 2001. 258 f. (Doctor Thesis in Administration) – Faculty of Economy, Administration and Contability, São Paulo Universty,São Paulo, 2001. Available at: <http://www.teses.usp.br/teses/disponiveis/12/12139/tde-04022002-105347/pt-br.php> Acesso em janeiro 2012.

[14] SAMPAIO, J., GOUVEIA, C., LIMA, H. A., SABOYA, F., *ITGreen: The Experience of Porto Digital Technology Park in order to Contribute to a Sustainable Innovation Habitat*, IASP World Conference on Science and Technology Parks, Talin, Estonia, 2012.

[15] MOREIRA, I. C. A inclusão social e a popularização da ciência e tecnologia no Brasil. Inclusão Social, Brasília, v. 1, n. 2, 2006. Available at:: <http://revista.ibict.br/inclusao/index.php/inclusao/article/view/29/50 > Acesso em maio 2009.

[16] MINISTÉRIO DA CIÊNCIA E TECNOLOGIA – MCT. Programa de Formação de Capital Humano em Software: Planos de investimento 2006-2012. 2006. Available at: <http://www.intepp.com.br/intepp/imgsite/artigos/23.pdf > Acess in may, 2009.

[17] PORTO DIGITAL - Relatório de Pesquisa para Mapear o Perfil da Oferta e Demanda de Qualificação Profissional em Tecnologia da Informação em Recife. 2011. Access in january, 2011.

STRATEGIES FOR ENHANCEMENT PUBLIC SERVICES ON TRANSPORTATION INFRASTRUCTURE IN BANDUNG (WEST JAVA, INDONESIA) ACCORDING TO THE NEEDS OF TOURISTS USING SERVQUAL INSTRUMENT AND QUALITY FUNCTION DEPLOYMENT (QFD) METHOD

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Abstract
Bandung has a vision of enhancing role as a service city and is supported by a mission to create and enhance the attractiveness of the city with the support of adequate transportation system. One of the major service industries in Bandung is the tourism industry. In these industry, transportation infrastructure is one of the important public service that will support developing tourism industry, Therefore, local governments have the responsibility to always improve transport infrastructure services so the rapidly growing tourism industry. The research objective is to determine the strategies for enhancement public services on transportation infrastructure in Bandung according to the needs of tourists with SERVQUAL instrument and Quality Function Deployment (QFD) method.
SERVQUAL instrument has been implemented before in studied about tourist's service quality and in public service on transportation service quality. and the QFD method has been implemented for quality improvement of goods and services. In this study, SERVQUAL and QFD was applied in public service quality especially in transportation infrastucture services.
The results of this study will help the local governments to determine the right strategy for enhancement public services on transportation infrastructure according to the needs of tourists and will add to the treasury of the appllication of SERVQUAL instrument and method of QFD in public service sector especially in transportation infrastucture services related to tourism .

Keywords: Strategy for Enhancement; Public Services on Transportation Infrastructur; The Needs of Tourists; SERVQUAL,QFD.

1. Introduction

1.1 Problem Background

The tourism industry is one of service-based industries. According to Ben Sukma, Indonesia's balance of payments will be surplus in the services sector if the government would boost the tourism sector. In 2007, revenues are donated from local tourists that visit to all tourist areas in Indonesia, nearly 25% (Rp 20 trillion) , donated by West Java and tourists visiting West Java so far is still concentrated in Bandung [1]. In 2012, The tourism sector have targeted 8 billion tourist that can add above Rp 81 trillion devisa [2]. Since the operation of Cipularang toll roads in April 2005, there was a surge in the number and frequency of tourist visits to Bandung, especially on a weekend. Studied from Harmoko [3] shows that 60% of the tourists that went to Bandung with private vehicles. This condition leads Bandung in a crowded and traffic jams. which would reduce the convenience of road users including tourists there are 18 pieces of service attributes of the transportation infrastructure in Bandung by tourists assessment. However, only a single attribute satisfy tourists because it has a positive value of the difference (between the expectations of tourists and assessment) and the satisfaction index above 100%. This indicates that the ministry of transportation infrastructure in Bandung have not been tourist satisfaction.

With the vision of Bandung [4] : increasing the role of city services that are supported by one of its mission to create and enhance the attractiveness of Bandung, with the support of adequate transportation system, the local government of Bandung needs to immediately follow up the results of the study above. By considering the wishes and needs of tourists to the transportation infrastructure services in Bandung, the improvements made by local government will further develop its tourism industry and the vision and mission of Bandung soon realized. Merts [5] said that one of the most effective method to capture the demands and needs of customers is the QFD method.

1.2 Research objective

This study aims to determine the strategies for the enhancement public services on transportation infrastructure in Bandung according to the needs of tourists with SERVQUAL instrument and (QFD) method.

1.3 The Importance of Research

1. The results of this study can be used by Bandung local government to determine the proper strategies for enhancement the public services on transportation infrastructure that it supporting tourism industry.
2. Expand the application of SERVQUAL instrument and method of QFD in public service sector especially in transportation infrastucture services related to tourism

3. Literature Review

Johnson and Scholes [6] define strategy as follows: Strategy is the direction and scope of an organisation over the long-term: achieves which advantage for the organisation through its configuration of resources within a challenging environment, to meet the needs of markets and to fulfil stakeholder expectations. Strategies exist at several levels in any organisation - ranging from the overall business (or group of businesses) through to individuals working in it. (1). ***Corporate Strategy*** - is concerned with the overall purpose and scope of the business to meet stakeholder expectations. This is a crucial level since it is heavily influenced by investors in the business and acts to guide strategic decision-making throughout the business. Corporate strategy is often stated explicitly in a "mission statement". (2). ***Business Unit Strategy*** - is concerned more with how a business competes successfully in a particular market. It concerns strategic decisions about choice of products, meeting needs of customers, gaining advantage over competitors, exploiting or creating new opportunities etc. (3). ***Operational Strategy*** - is concerned with how each part of the business is organised to deliver the corporate and business-unit level strategic direction. Operational strategy therefore focuses on issues of resources, processes, people etc.

Based on Article 1 of law No.9,1990, Tourists are people who traveling or conducting some of these activities, which is voluntary and temporary to enjoy tour objects and tour attraction. Tourism is anything related to the operation of tourism, including the exploitation of tour objects and tour attractions as well as related efforts in the field. Tour object and tour attraction are everything that being tourism target [7].

3.1 Transportation infrastructure

Grigg in Kodoatie [8], divide the infrastructure into four major sections based on its specifications. The four major sections are the transportation infrastructure, the main public service infrastructure, the infrastructure of public utilities, and the infrastructure of state services.

In Regional Autonomy Law no. 32 of 2004, in pasal 14 confirms that the affairs of government which is a local public service, shall be performed by the regency and city areas include: public works, health, education and culture, agriculture, communications, industry and trade, investment, environment, land, cooperatives and labor. In connection with public works including the transportation infrastructure. Transportation infrastructure categories are: roads and bridges, railroads, public transportation (various types of public transport), airport, air transport, sea ports, transport ships, and ferry/sea traffic, bike blanes, sidewalks, and green footpath.

3.2 Transportation Infrastructure Systems In Tourism Services

Transportation infrastructure service system is modified from the general tourism system of Lepier in Marpaung [9] showing that the movement of tourists from the origin region to the popular tourist destination, especially towards the tourism object and attraction. The transportation infrastructure system in tourism services can see in fig.1 below.

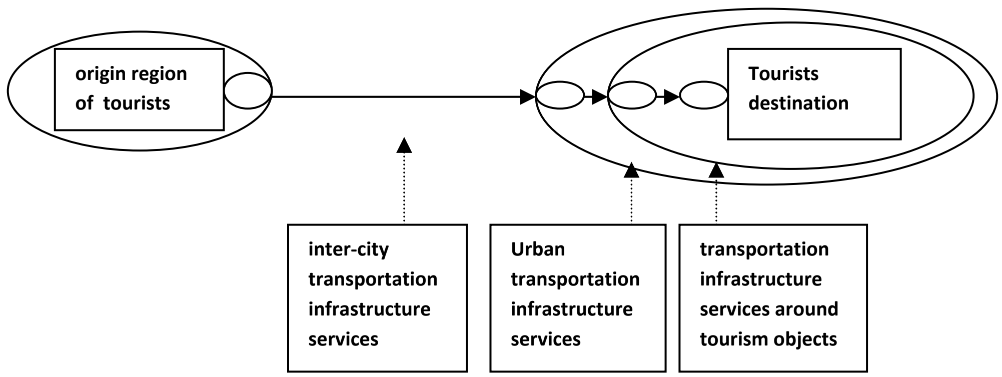

Fig.1 Transportation Infrastructure Systems In Tourism Services

In this figure 1 shows that the necessary transportation infrastructure services including inter-city accessibility and accessibility of urban transportation. Transportation Infrastructure service or accesibility of urban transportation, can be divided into accessibility to / from the location and accessibility of around the tourism objects/sites. For accessibility of urban transportation that will determine the accessibility to / from the location of attractions, such as: the existence of a main road, the other alternative road access, traffic management, traffic signs / directions, tourist information management, paratransit/taxi and public transportation lines, time and transportation costs. For accessibility of urban transportation that will determine the accessibility of tourism

object, such as: traffic management around the site, area and distance to find parking, condition of sidewalks /

pedestrian, the conditions in the parking lot, paratransit/taxi and public transportation lines, traffic impact of tourism, the design/lay out for vehicles maneuver and the rise/fall visitors.

3.3 Service Quality and Consumer Satisfaction

Gronroos [10] defined that perceived service quality as a result of the comparison between customer expectations with actual performance of service. Services is any act that was offered by one side to another that is essentially intangible (not a physical shape), and do not result in ownership of something. Kotler [11] explain that however, production of services can be associated with a physical product or not.

According to Mangkoesoebroto [12], public goods/services are goods/services that can not be provided through the transaction between seller and buyer. The characteristic of the public goods/services are non-rival and exclusion. Because public services including transport infrastructure services is seen as a service, then the measurement of quality of public service in transport infrastructure also includes the variables of service quality.

Parasuraman et al.[13], developed the well-known five-gap model of service quality (**SERVQUAL**) : Tangibles (direct evidence), including physical facilities equipment, personnel and infrastructure of communication; Reliability, the ability to deliver the promised services quickly, accurately and satisfactorily; Responsiveness, the desire of staff to assist customers and give service responsively; Assurance/insurance, including the knowledge, skills, courtesy, and trustworthiness of staff-owned, free from danger, risk or doubt; Empathy, including easy of approach and contact the officer, the ease in providing information, and to know and understand the specific needs of customers. SERVQUAL instruments uses the perspective of the consumers to evaluate the expectations of consumers regarding similar kind of service quality. Yuan et al wrote that the general SERVQUAL instruments have been tested and used on transport industry, transportation system and transport market [14].

The service quality have relationship with satisfaction. Satisfaction is the degree of one's feelings after comparing the performance/results from their experience with their expectations (Oliver [15]). It is also evident in tourism research González, Comesañaa [16] & Baker & Crompton [17]. Studied Chen et al. [18] result that service quality has positive significant relationship with tourist satisfaction. Bolton & Drew [19] published first empirical study that reported a difference between service quality and perceived service value, they confirmed that service quality has a direct effect on value. Their results were consistent within those of prior exploratory research. This relationship has been further confirmed in several service contexts, such as Chen [20] in transportation service and Kuo et al. [21] in mobile service. According to Chen and Chen [22] and Hutchinson et al. [23], this relationship is also found in the tourism context; when tourists have a high perception of tourism sites, they have positive behavioral intentions in terms of word-of-mouth and future visits. Other studied from Hu et al. [24] indicates that delivering high quality service and creating superior customer value can result in achieve high customer satisfaction, thus effecting the firm's corporate image, and ultimately leading to consumer retention.

3.4 Quality Function Deployment (QFD)

QFD is a product development methodology originated in Japan since 1960, Initiated by Shigeru Mizuno and Yoji Akao of the Tokyo Institute of Technology. QFD has quickly spread to the servicing industry such as banking, insurance, logistics, tourism, hotel and medical in the 1980s. It is today established as an important quality tool in the design process (Akao [25] and Mazur [26]). in the future, Akao [27] said that QFD will be also positioned as an effective tool for quality assurance of systems in the information age.

Akao [28] defined that QFD as a method for defining design qualities that are in keeping with customer expectations and then translating the customer requirements into design targets and critical quality assurance points that can be used throughout the production/service development phase. QFD is a comprehensive quality system that systematically links the needs of the customer with various business functions and organizational processes, such as marketing, design, quality, production, manufacturing, sales, etc., aligning the entire company toward achieving a common goal. The QFD methodology can be used for both tangible products and non-tangible services, including manufactured goods, service industry, software products, IT projects, business process development, government, healthcare, environmental initiatives, and many other applications [29].

Governmental and non-governmental (NGO) organizations share many of the same challenges as for-profit corporations. Instead of the profit incentive, their goal is to deliver the best to their customers (clients) that their budget will allow. Innovation, of course, is often a key opportunity to get more bang for the buck. With a few changes, QFD can bring the power of Voice of the Customer (VOC) to helping these projects develop faster, better, and cheaper solutions. Research by Mazur, QFD Red Belt®, QFD Institute and Theodore Hopwood II, P.E., Kentucky Transportation Center, University of Kentucky adapted the VOC tools to address the many conflicts any civil project faces when trying to satisfy a broad range of economic, political, social, and functional needs of their constituents. Such challenge is not unique to transportation routing; it occurs regularly with military base, park, community, and other types of construction. At the conference, the authors presented examples from real road construction projects [30].

Miyoung and Haemoon, 1998 in Masaudi [31] have used SERVQUAL in house of quality design to measure customer satisfaction in return for service quality. In this study, SERVQUAL has been modified to the hospitality industry and used in order to consider the guests' expectations and needs in the early stages of hotel service design. Sangeeta et al. [32], Identifies the gap between customer expectations (students within selected educational institutions) and perceptions of the actual service received (the quality of those institutions) via SERVQUAL methodology. Then, determines the set of minimum design characteristics/quality components by QFD. Key &

Pawitra[33] proposes an integrated approach involving SERVQUAL, QFD and Kano's model that helps organizations to evaluate customer satisfaction, to guide improvement efforts in strengthening their weak attributes.

4. Methodology

4.1 Limitation of The Research

This study is limited to the accessibility of urban transportation and was conducted at tourist resorts frequented by tourists when traveling to Bandung, that is at the museum of geology, Saung Angklung Mang Ujo, shopping tourism products Cihampelas jeans, Factory Outlet - Factory Outlet is located on RE Martadinata road and Ir. H. Juanda, and the shoe industry in Cibaduyut. The samples were selected based on simple random sampling technique and calculation of minimum number of samples is done using Bernaulli formulla**.**

4.2 Data Collection Technique

Primary data collection with questionnaire tool carried out by using Likert scale format with range values 1 for the statement is not important / very dissatisfied to 5 for a statement of values is very important / very satisfied. The validity of the questionnaire was tested by using the formula of correlation product moment and reliability of the questionnaire was tested with Cronbach Alpha method. The questionnaire was developed using SERVQUAL instrument that was applied at transportation infrastructure service that related with tourism.

4.3 Data Processing

Data processing performed by the method of Quality Function Deployment (QFD) with the following stages:

1. Costumers Requirement, which will identify all the tourists demand about transportation infrastructure services based on literature study.

2. Planning of Matrix, which is compiling questionnaire that will capture the needs and interests of tourists about transportation infrastructure services. Further more, the data that was obtained will be processed as follows : (a). Analysis of Quadrant Mapping, that is mapping the expected value and the assessment by tourists about transport infrastructure service in a cartesian diagram.(b). Doing Difference Analysis And Counting Tourists Satisfaction Index. If index of tourist satisfaction less than 100%, it means that tourists are not satisfied with the service provided.

   Further more, data obtained will be used to compile the QFD planning matrix, with the input attributes that meet the criteria: (1). Attributes that have a negative value of the gap / difference , (2). Attributes that have index of satisfaction less than 100%, and (3). Attributes that are mapped to quadrants A and C.

3. Identifying Technical Characteristics, which translates from tourists demand, done by observation to the transportation infrastructure services and conduct interviews with the Department of Transportation and the Department of Tourism. Demand of Tourists was translated into the technical characteristics that provide an overview of service characteristics that will be developed to meet the needs of tourists

4. Determines Matrix of relationship between the needs of tourists and technical characteristics. With this matrix, we will get priority strategies associated with house of quality so that the strategy is expected to be right on target. Strategic priorities will be assessed based on the score 5 for the strong correlation, score 3 for moderate and score 1 for the weak correlation. Furthermore, based on the data processing that has been described above, then was performed a descriptive analysis.

4.4 RESULTS AND DISCUSSION

In this study, there are 18 attribute that was choosen by tourist from 33 attribute in quesionare of transportation infrastructure services in Bandung. Furthermore, after the 18 pieces of attribute is mapped in a cartesian diagram, found that in quadrant A : are attributes that is considered very important but have not been tourist satisfy, there are seven pieces of attribute. In quadrant B (attributes are considered very important and has been satisfying tourists) there are 4 pieces of attribute. In quadrant C (attributes are considered less important and have not been tourist satisfy) there are 2 pieces of attributes, and in quadrant D (attributes are considered unimportant but very satisfy tourists) 5 pieces of attribute (Harmoko & Zuraida [34]).

QFD planning matrix was made with criteria: attributes that have a value of the gap / difference is negative, attribute satisfaction index of less than 100% and the attributes that are mapped to quadrants A and C. There are attributes : (1). Efficiency of time / cost from / to the tourist sites, (2). Certainty of time / cost from / to the tourist sites, (3). Optimization of the traffic arrangements in Bandung, (4). Availability of special parking lot at tourism sites, (5). Comfort in the parking lot and on pedestrian / sidewalk at tourist sites, (6). Ease of finding parking at tourist sites, (7). Saturation level (full / absence) of parking spaces around the tourist sites, (8). Levels of traffic jam around the main tourist sites in Bandung, (9). Availability of taxi base and adequate public transportation around the tourist sites

A. Translation of Tourists Needs and Expectations Into Product Attributes and Operational of Attributes

To meet the needs and expectations of tourists, the needs and expectations are translated first into product attributes and operational attributes. The result can be seen in Table 1.

B. Determine the matrix of cause and effect relationship

Before translating the needs and expectations of tourists into the technical characteristics, it is first determined a causal link between the expectations of tourists who have been translated into product attributes, especially among cause of and operational attributes. The cause factors are rouped into five main factors, namely: human (man), equipment (machine), materials (materials), method (method) and environmental factors (Environment).

C. Identification of Technical Characteristics Based on attribute of Tourists Needs

Based on the above matrix, we make observations on the existing transportation infrastructure services, and conducted interviews with Department of Transportation and the Department of Tourism to develop a variety of technical characteristics which can represent the factors that cause the expectations of tourists hasn't unfulfilled.

The technical characteristics of the transportation infrastructure services in Bandung can be formulated as follows:

a) The need to develope transportation infrastructure such as infrastructure design revisions, overpass / underpass, bridge crossings, pedestrianisation, alternative access road, parking area and alternate /
b) Backup, and availability of taxi bases or public transport with all supporting facilities.
c) Expand the information about the pattern / periodic traffic density, traffic conditions in different door
d) motorway / road toll-gate, the condition of congestion in Bandung and surrounding area and information about alternative access points.
e) Improve traffic management and traffic restriction policy, and management of road maintenance.
f) Structuring the tourist area by using a partnership with surrounding communities, both in managing the entrepreneurial / street vendors, security and order, and parking.
g) Enforce regulations / permits that can guarantee the preservation of smooth traffic.
h) Vehicles and people from street vendors disorders and on-street parking and the need for the implementation of punishment for tourist area managers that not anticipate the negative impact on surrounding traffic.
i) Implement service management environment that will ensure the cleanliness and comfort and beauty / preservation of tourist areas.

j) The need for human resource training, including police officers traffic, parking, safety / security and communities around the tourist area involved in the tourism industry will be able to wake up to a positive image for the development of sustainable tourism in Bandung.

Table 1. Translation of Tourists need and expectation Into Product Attributes and Operations Atribute

No	Needs and Expectations of Tourists	Product attributes	Operational attributes
1	Efficiency of time / cost from / to the tourist sites (X12)	The existence and smoothness of road access	Level of service of access roads and Toll roads
2	Certainty of time / cost from / to the tourist sites (X13)	Traffic patterns and the existence of nuisance	Information about the pattern and level of traffic disruption
3	Optimization of the traffic arrangements in Bandung (X14)	The existence of traffic management	The existence of traffic engineering and staff
4	Availability of special parking lot at tourism sites (X16)	The existence of adequate parking area	The existence of adequate off-parking
5	Comfort in the parking lot and on pedestrian / sidewalk at tourist sites (X21)	The existence of adequate space with all supporting facilities	Low conflict, presence of toilet, prayer room and cafe, safe sidewalk access
6	Ease of finding parking at tourist sites (X22)	Adequate and strategic location	The existence of information about alternative places
7	Saturation level (full / absence) of parking spaces around the tourist sites (X29)	Capacity of parking spaces and adequate management	Capacity / Management adjusted to pattern and level of traffic
8	Levels of traffic jam around the main tourist sites in Bandung (X11)	Level of service and disruption of access roads and treatment efforts	Traffic management and tactical anticipation and road widening access
9	Availability of taxi base and adequate public transportation around the tourist sites (X17)	The existence of adequate taxi / public transport base	Comfortable location, preservation of public order and the existence of public transport

D. Preliminary design of "House of Quality" (HOQ)

At this stage, we are identifying the relationship between the row matrix/attributes and column matrix/technical characteristics by discussions with the Department of Transportation and the Department of Tourism. Identification of strong or weak links in the product design matrix (House of Quality) is determined by rate:, score 5 for the strong correlation, score 3 for moderate and score 1 for the weak correlation. '_' for there is no relationship at all.

Due to space constraints, the judmen or grounds for the value of the relationship between needs attribute with technical characteristics that can be explained only efficiency of time attribute, where these attributes have a very strong relationship with the availability of adequate physical infrastructure, both starting from the design location of the toll booth , the road network in Bandung / primary and secondary arteries, the availability of overpass underpass, overpass, pedestrianisasi and others that can substantially reduce the potential and the number of points of conflict between traffic, and therefore given a score of 5. In addition, the efficiency of time may also have a strong relationship with traffic management improvements, including traffic lights control efforts in an integrated manner, so it given value of 3. The other attributes are also carried out assessments in the same way.

Based on level of relationship in relationship matrix and the average expectations of tourists, house of quality can be constructed by counting / summing the multiplication results both in absolute and relative terms. From this relative value it would be seen the order of priority (based on the sequence of relative percentage) of various technical characteristics in order to improve the service quality is guaranteed in accordance with the wishes / expectations of tourists. This priority order describes the strategies that should be built in an effort to improve the transportation infrastructure so that can be achieved optimality of public service of tourism in Bandung.

Henceforth, the priority order of the technical characteristics as the basic strategy in efforts to improve transportation infrastructure services in Bandung. The order of priority, it appears that the effort to develope transportation infrastructure (number-1) is the technical characteristics that have the most important priority (23.55%) to be developed in order to improve the quality of tourism services that have been adjusted with and based on the expectation / the real needs of tourists. The technical characteristics on the lowest priority (the order-7) is the effort to implement environmental care management with the relative percentage of only 9.06%.

5. Final design "HOQ" Considering Correlation Between the Characteristics of Technical

The next stage to identify the relationship between columns or between technical characteristics to explain the level of power among the column matrix has been determined. Level of strength of this relationship, plotted on a matrix of product design (House Of Quality) to complete the "roof" of the "house of quality" with the category and the notation: 'o' for the strong positive correlation, 'x' for the correlation is less strong negative or strong positive, '-' for there is no relationship.

Furthermore, to determine the level of relations between the technical characteristics for a more complete and thorough, can be seen in Figure 1 of the "House of Quality" in the "roof" of his. Determination of the relationship between the technical characteristics of the HOQ images, can be explained by the following reasons:

That the development of Transportation Infrastructure (order of priority to-1) Very Strong Relationship (o) to the Road Maintenance Management and management / traffic restrictions (technical characteristics of the order-2) due to the presence of transportation infrastructure in maintaining the function / service level is strongly influenced by the quality of road conditions . Likewise, the traffic management efforts that can be guaranteed a smooth traffic as tolerated when the limitations of the land / road capacity and funding, it. In addition, the technical characteristics with the first order of priority, are also strongly correlated (o) with the technical characteristics of the Enforcement of regulations / permits (to the order-5). But less strongly associated (x) with the technical characteristics of the arrangement (the order-3), human resource training (ranked 4th) and expand the information (the order-6), and no relationship (-) with the technical characteristics of the environment of service management (number-7). are the technical characteristics of the arrangement (the order-3) are very strong correlation (o) the environment of service management (order-7), and expand the technical characteristics of information (the order-6) is very strongly correlated (o) the training of human resources (number to-4). Furthermore, for the relationship between the technical characteristics of the others made the same way and due to page limitations, it is not described in this paper.

General Recommendations Strategies Based on Total Results of "HOQ"

Based on the design of HOQ, we make recommendation about general strategy for transportation infrastructure improvements in order to improve public service quality of tourism in Bandung (with the development priorities based on the magnitude of the relative percentage) as follows:

- Development of transportation infrastructure facilities, combined with efforts to improve traffic management and by enforcing regulations / licensing is expressly in order to achieve optimization of the overall transportation system services in Bandung. (The relative percentage of 52.83%).
- Structuring the tourist area with a combined partnership with the efforts to implement environmental care management in order to guarantee security, order, cleanliness and beauty / environmental sustainability and the creation of sustainable tourism development (the relative percentage = 25.10%).
- Expand the spreading of information to guarantee the certainty and convenience for tourists in making decisions, combined with the efforts for human resource training, especially for those who associated with the service / tourism information (the number of relative percentage = 22.07%).

6. Conclusion

By using the SERVQUAL we can know what are tourists needs and expectations attributes and by aplication the QFD method we can design of HOQ. Base on it we can recommendation about the general strategies for enhancement public services on transportation infrastructure in Bandung according to the needs of tourists are : (1). Development of transportation infrastructure facilities, combined with efforts to improve traffic management and by enforcing regulations / licensing is expressly in order to achieve optimization of the overall transportation system services. (2). Structuring the tourist area with a partnership that combined with the implementation of service management environment in order to guarantee security, order, cleanliness and beauty / environmental and the creation of sustainable tourism development. (3). Expand the spreading of information to guarantee the certainty and convenience for tourists in making decisions, combined with the efforts for human resource training, especially for those who associated with the service / tourism information

Reference

1. Koran Kompas (2008). Kunjungan Wisman di Jawa Bara" , 14&28 Februari 2008.
2. Koran Pikiran Rakyat (2012), Pariwisata :Jumlah kunjungan naik 8.81%, hal.: 22.
3. Harmoko, H. R. (2009). Studi Tentang Karakteristik Dan Motivasi Wisatawan Serta Identifikasi , Penilaian Dan Harapan Wisatawan Terhadap Atribut Infrastruktur Transportasi Di Kota Bandung, Laporan Penelitian.
4. Pemerintah Daerah provinsi Jawa Barat, "Arah Kebijakan tahun 2005-2006"
5. Merts, Joseph P. (2008). Saving Time by Voting Blind, Blending the Voices of Disparate Customers, Planning for Failure: HOQ vs. FMEA, May 10th, 2008
6. Johnson and Scholes (Exploring Corporate Strategy), Strategy : What is strategy? www.goegle.com
7. Pemerintah Kota Bandung, Bappeda Kota Bandung. (2006), Rencana Induk Pengembangan Pariwisata Daerah Kota Bandung, Bandung
8. Kodoatie R.J. Pengantar manajemen Infrastruktur, Pustaka Pelajar, Yogyakarta.
9. Marpaung, H. (2002). Pengetahuan Kepariwisataan, Alfabeta, Bandung.
10. Gronross C. (1984). A service quality model and its marketing implication. European Journal of Marketing, Vol. 18(4), 36-44
11. Kotler, P. (1994). Marketing Manajemen, Analysis, Planning, Implementation and Control, New Jersey: Prentice Hall International, Inc
12. Mangkoesoebroto, G. (2001). Ekonomi Publik, BPFE, Yoyakarta.
13. Parasuraman, A., Zeithaml, V. A., Berry, L. L. (1990).Delivering Quality Service: Balancing Customer Perceptions and Expectations. The Free Press: New York.
14. Yuan,Chih Huang; Wu, Chih-Hung; Jovan Chia-Jung Hsu. (2006). In Using Importance-Performance Analysis in Evaluating Taiwan Medium and Long Distance National Highway Passenger Transportation Service Quality, Journal of American Academy of Business, Cambridge, 8. 2 (Mar 2006): 98-104.
15. Oliver, R.L.1980). A cognitive model of the antecedence and consequences of satisfaction decisions, Journal of Marketing Research, Vol 17, September, pp 46-9.
16. González, M.E., Comesaňareaa, J. A. F. (2007). Assessing tourist behavioural intentions through perceived service quality and customer satisfaction. Journal of Business Research, 60(2), 153-160.
17. Baker, D. A. And Crompton, J.L. (2000). Quality, satisfaction and behavioral intentions. Annals of Tourism Research, 27 (3), 785-804.
18. Chen, Chien Min; Lee, Hong Tau; Chen, Sheu Hua; Huang, Tsun Hung. (2011). Tourist behavioural intentions in relation to service quality and customer satisfaction in Kinmen National Park, Taiwan,The International Journal of Tourism Research ,13. 5 (Sep/Oct 2011): 416.
19. Bolton, R.N., and Drew, J.H. (1991). A multistage model of customers' assessments of cervice quality and value. Journal of Consumer Research,77 (March), 375-384
20. Chen, C.-F. (2008). Invesgating structural relationships between service quality, perceived value , satisfaction, and behavioral intentions for air passengers : Evidence from Taiwan. Transportation Research Part A : Policy and Practice, 42(4), 709 – 717.

21. Kuo, Y.-F., Wu, C-M., and Deng, W.-J. (2009). The relationships among service quality, perceived value , satisfaction, and post-purchases intention in mobile value-added services. Computers in Human Behavior, 25(4),887-896
22. Chen, C.-F., and Chen, F.-S. (2010). Experience quality, perceived value, satisfaction and behavioral intentions for heritage tourists. Tourism Management, 31 (1), 29-35.
23. Hutchinson, J., Lai, F., and value, customer satisfaction, and image: an empirical study", *The Service Industries Journal* , 29. 2 (Wang, Y. (2009). Underestanding the relationship of quality,value, equity,satisfaction, and behavioral intentions among golf travelers. Tourism Management, 30 (2), 298-308.
24. Hu, Hsin-Hui (Sunny); Kandampully, Jay; Juwaheer, Thanika Devi. (2009), "Relationships and impacts of service quality, perceived Feb 2009): 111.
25. Akao, Y.(1990), "History of Quality Function Deployment In Japan, The Best on Quality", International Academy for Book Series, 3, Hanser, New York, NY: 183-96
26. Mazur, G.H. (1994)." QFD Outside North America – Current Practice in Europe", The Pacific Rim, South Africa and Points Beyond, Proceedings of the 6th Symposium on QFD.
27. Akao, Y. , 1997, "QDF : Past, present and Future International Symposium on QFD'97 - Linkoping O", Asahi University.
28. Akao, Y.(1990), "History of Quality Function Deployment In Japan, The Best on Quality", International Academy for Book Series, 3, Hanser, New York, NY: 183-96
29. http://www.qfdi.org/what_is_qfd/what_is_qfd.htm, QFD Institute on line
30. QFD News Letter on line
31. Masoudi, Ali, 2008, "A QFD and SERVQUAL Approach to Hotel Service Design", Aysun Kapucugil Ikiz İşletme Fakültesi Dergisi, Cilt 9, Sayı 1, 2008, 17-31
32. Sangeeta S.; Banwet, D.K. & Karunes, S. (2004). "A SERVQUAL and QFD Approach to Total Quality Education A Student Perspective", International Journal of Productivity and Performance Management, 53(2): 143-166.
33. Key, C. T. & Pawitra, T.A. (2001)." Integrating SERVQUAL and Kano's Model into QFD for Service Excellence Development", Managing Service Quality, 11(6): 418–430.
34. Zuraida, umi and Harmoko, H. (2012). "Identification of Management Improvement of Tourism Public Services on Transportation Infrastructure Sector in Bandung Based On Tourists Demand, Proceeding the International Conferrence Technology of Management, Bandung – Indonesia.

BUSINESS-PERSPECTIVES STUDY FOR LUNG DISEASES DIAGNOSIS APPLICATION

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Abstract

This paper describes the business perspective study of The Lung Diseases Diagnosis Application.

From the technical point of view, The Lung Diseases Diagnosis Application consists of software and hardware components which formed a first-hand diagnosis tool of the lung diseases, such as Influenza and Tuberculosis (TBC), to support the paramedics/doctors in lung diseases diagnosis. One of the most common and proven technique for lung disease diagnosis is the Auscultation, the term refers to listening to the internal sounds of the respiratory system (breath sounds), usually by using a stethoscope. However, this diagnosis way depends heavily on the listening skills and judgment of the paramedics/doctors alone. In this research, we develop a new diagnosis tools by adding a front-end equipment for the lung diseases diagnosis application: handphone equipped with a highly sensitive microphone, to record the breath-sound. This breath-sound is later be processed to generate the lung sound, which is approximately similar with the lung-sound heard and recorded by a stethoscope and the lung-sound is analysed to diagnose whether the patient's lung is healthy or not. This application would hopefully support the paramedics/doctors mobility to rural areas as well as remote diagnosis, and to provide a more accurate lung diseases diagnostic result. This application is now being designed and developed by the School of Electrical Engineering and Informatics, Institut Teknologi Bandung (STEI ITB) reseach team.

Besides the technical perspective, the business perspective holds an important role in the success of a software/application. Hence, this paper describes some business perspective: application business model; preliminary feasibility study: legal aspect, environmental aspect, marketing aspect, technology aspect, management and resources aspect. The financial aspect, including the invesment and its return aspect is not within the scope of this first business research, and will be studied in futher study.

Paper Content

1. Application Overview

This application was inspired by Auscultation, which is the paramedics/doctors' skill for listening to the internal sounds of the body, usually using a stethoscope; based on the Latin verb auscultare "to listen". The act of listening to body sounds for diagnostic purposes has its origin further back in history, possibly as early as Ancient Egypt. Auscultation is a skill that requires substantial clinical experience, a fine stethoscope and good listening skills [8]. By listening to the lung sound, we would know what type of lung sound occurs such as: crackles, wheezes, stidor, rhonchi, etc. and identified which part of lung needs further investigation/treatment.

One of the examples of the adventitious breath sounds is the late inspiratory crackles (rales) begin in late inspiration and increase in intensity. They are normally higher pitched and can vary in loudness. These adventitious breath sounds resemble the noise made when salt is tossed onto a hot pan. These sounds are heard over posterior bases of the lungs. The waveform diagram is in the following Fig. 1, and the sound of the late inspiratory crackles can be found in [10]:

Fig. 1. Late inspiratory crackles waveform

The breath of human can be recorded and then processed to obtain the lung sound. This has been done by [7], where the breath sounds/signals are recorded by a free internet-voice-mail service, and for each recording, a date-stamped audio file was produced. The breath sounds were then transformed into lung-sound then using standard techniques of lung-sound analysis and sound-frequency spectrograms can be calculated and viewed and later be used to analyze an asthma suspect [7].

From research [18]-[21], the process flow of the lung disease diagnosis application is depicted in the following Fig.2:

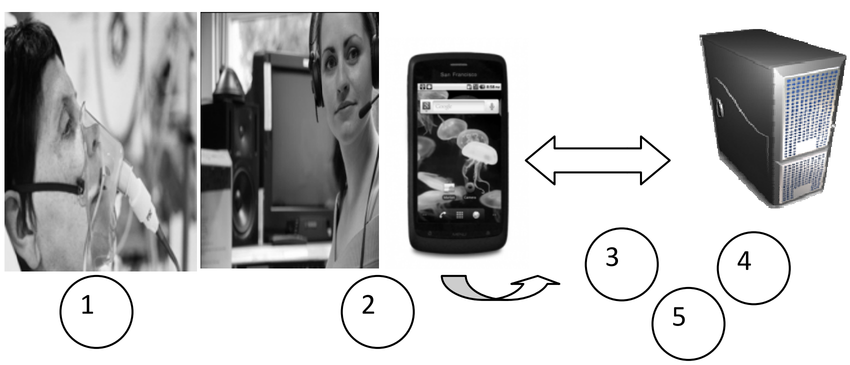


Fig. 2 The process flow of the lung disease diagnosis application

The lung/respiratory disease diagnosis process flow is as follows:

(1) Upon a lung diseases suspect report, the paramedic would come to the remote/rural area and do the diagnosis. The breath sound is recorded by a handphone with a sensitive microphone and voice recording.
(2) The breath-sound file is sent the central server.
(3) The breath sound file is processed and separated into the lung sound and the trachea/upper-respiratory sound.
(4) After these frequencies has been separated, both the lung sound and trachea/upper-respiratory sound frequencies are stored into the central server, to be analyzed and compared with the lung-sound and upper-respiratory-sound database from past patients. The software would diagnose whether the suspect is infected the respiratory

diseases or not from the lung-sound and upper-respiratory-sound diagnosis.
(5) The diagnosis result is sent back to the paramedic's cellular phone for immediate curative actions.

2. Feasibility Study

2.1. Legal aspect

The legal feasibility study investigates all the information sources which inspired this research. The first source is about auscultation, which was studied from various sources in internet, including [10a], which described about the lung sound, and [10] which described about lung-sound generated from auscultation process and some adventitious breath sounds and their frequency waveform format. These first references discusses about the auscultation only, by using stethoscope, as the primary and the only way to diagnose the lung sounds.
Other reference [7] discusses about the principle of how to record the human breath-sound and tranform it into lung-sound utilizing mobile phones. This reference gives knowledge to alternate the stethoscope with sound recording system, however the scope of this research is only for asthma diagnosis.

Our research broadens the diagnosis purposes to various diseases possibly infects all respiratory sub-systems, specifically the lung organ. This is possible, because the recorded breath sound is processed and separated into lung-sound and upper-respiratory sound, and compared with various adventitious/abnormal lung-sound database, to identify what kind of disease infect the patient.

There is another computer-based application developed by research firm STAR Analytical Services [23], which diagnoses respiratory illnes by analyzing coughs, and will be developed into mobile-phone version as well. However this application analyzes coughs only, while our application analyze breath sounds which hopefully would give a broader range of diseases and a more accurate result.

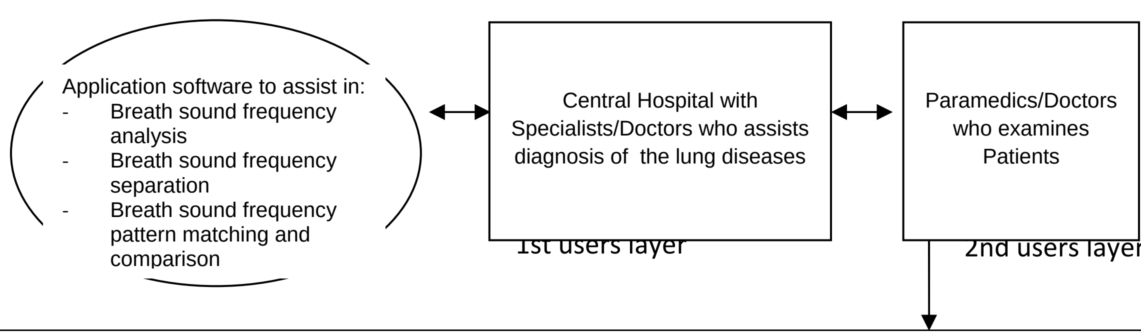
Because all of these references and information are public domain and accessible through internet, there is no legal obligation pursued for our research and application development.

2.2 Management and resources aspect

The management and resources feasibility study first describes about (1) application business model and (2) the management of application service provisioning.

2.2.1 Application business model

The application business model is in the following Fig. 3:



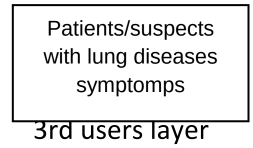


Fig. 3. The application business model and its users

The partnership will be established with the 1st users layer, therefore any agreement including confidentiality agreement will be with this users. The 2nd and 3rd users layers will set the relationship with the 1st users layer.

2.1.2 The management of application service provisioning

The management of application service provisioning will be conducted by School of Electrical Engineering and Informatics (STEI ITB) team as the application researcher, developer and owner, and Telkom Institute of Management team as the application service provisioner. These teams will form partnership in research, development, provisioning and operational of this application.

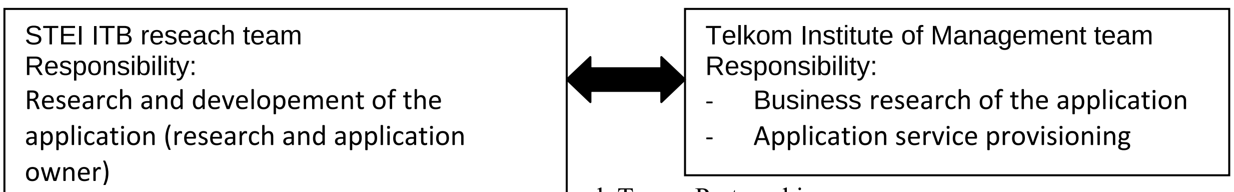


Fig. 4. Research Teams Partnership

2.2 Marketing aspect

The marketing feasibility study briefly describes about this application's target market, which is the 1st users layer (from Fig. 3), including:

(1) Balai Besar Kesehatan Paru Masyarakat Kota Bandung (Council of Public Lung Health in Bandung). This council is also the main user who will be within the research and development team
(2) Hospitals
(3) Puskesmas
(4) Red Cross council
(5) Registered council/group of doctors/paramedics

2.3 Technological aspect

In the technological feasibility study, (1) the study of existing lung diagnostic tools and (2) the study of available and most suitable telecommunication platform are conducted.

2.3.1 Study of existing lung diagnostic tools

According to [14], there are several diagnostic methods to diagnosis TBC/lung diseases such as :

(1) Auscultation : the way of examining the human body by using stethoscope, to listen to the internal part of the human body, including lungs.
(2) Bronchoscopy: a test to view the airways and diagnose lung disease using bronchoscope equipment.

(3) Chest CT scan: an imaging method that uses x-rays to create cross-sectional pictures of the chest and upper abdomen.
(4) Chest x-ray: an x-ray of the chest, lungs, heart, large arteries, ribs, and diaphragm.
(5) Routine sputum culture: a test of secretions from the lungs and bronchi (tubes that carry air to the lung) to look for organisms that cause infection.

However, there are some drawbacks by utilizing these methods only. Auscultation, which has been recognized as the most common and proven first-hand method, requires direct contact with the patients and can not applied when patients are remote from paramedics/doctors/hospitals. The examination also depends heavily on the listening skill and judgement of the paramedics/doctors alone, therefore bias could exist. Bronchoscopy also requires direct contact with the patient, and insertion of bronchoscope equipment into the airways through the nose or mouth could cause discomfort, usually this is for an advanced diagnosis. Chest CT scan is an equipment which can give accurate diagnosis, however this equipment requires high cost investment. Chest x-ray although a more common equirement, is also high cost in investment, and requires special laboratory.

The summary of benefits and drawbacks of several lung diagnosis methods is in the following table:

No	Method	Benefits	Drawbacks
1	Auscultation	Simple yet long-life and proven method	Requires direct contact with the patients and can not applied when patients are remote from paramedics/doctors/hospitals. Also depends heavily on the listening skill and judgement of the paramedics/doctors alone, therefore bias could exist.
2	Bronchoscopy	Sight observation directly to the internal patient body, therefore any infection can be seen	Requires direct contact with the patients, and insertion of bronchoscope equipment into patients' airways could cause discomfort, usually this is for an advanced diagnosis.
3	Chest CT scan	Accurate diagnosis by sight observation of lung and overall respiratory system	Requires high cost investment.
4	Chest x ray	Accurate diagnosis by sight observation of lungs	Requires high cost in investment, and special laboratory to keep the equipment
5	Routine sputum culture	Quite fast and low-cost diagnosis method, requires 2-3 days time only.	Quite accurate, however this diagnosis requires specific test in a laboratorium, and requires patient's sputum transportation to the nearest hospital/puskesmas.

These drawbacks would hopefully be overcome by this new lung diseases diagnosis application for several reasons: (1) the major investment is performed one time for the research, development and implementation of the application (the application on computer server, cloud computing and telecomunication infrastructure and handphone application) and the recurring investment is only on the handphone for the paramedics/doctors registered to utilize this application (2) the mobility of paramedics/doctos is accomodated, because the tools to be brought is only the handphone (3) Later on, the diagnosis can be performed remotely, as long as there is handphone/telephone connected to this application from the patients/suspects remote sites (4) The diagnosis accuracy is increased, because the diagnosis is performed by analysing the breath sound frequency and supporting application rather than depending on the paramedics/doctors/judgment alone only.

2.3.2 Study of available and most suitable telecommunication platform

There is several telecommunication platform available to connect the application server and the application within handphone:

- CDMA infrastructure
- GSM infrastructure
- Fixed phone infrastructure

The implementation would be conducted in CDMA infrastructure for several reasons:

(1) CDMA infrastructure allows mobility and offers good quality of data and voice infrastructure. PT. Telkom's infrastructure for CDMA, Telkom Flexi coverage has reached to overall Indonesia including rural area

(2) There are several middle-end handphone with sophisticated voice recording has already been implemented in CDMA infrastructure such as:
    a. ZTE Blade N880
    b. Huawei Ideos U8150

    These handphones have been equipped with Qualcomm MSM-7277 chipset which offers excellent voice recording capability, with embedded, and if required add-on microphone with sensitiviity of 98 dB $\pm$ 3 dB at 1 Khz.

(3) CDMA operational cost is low-cost, therefore it is suitable to send high volume of breath-sound recording and sound frequency image data.

Telkom CDMA Infrastucture, Telkom Flexi, provides 2 ways of data communication:

1. PDN: communication media to gateway internet utilizing Packet Data Network (PDN) access through Telkom Flexi network. Dial-up access is supported by CDMA 2000-1x with data speed of 153,6 Kbps.
2. Flexi Mobile Broadband: utilizing EVDO (Evolution Data Only/Optimized) with data speed of 3.1 Mbps. The coverage of Telkom Flexi EVDO in Indonesia is in the following map:

Fig. 5. Telkom Flexi EVDO coverage map

2.4 Environmental aspect

The environmental feasibility study is about the business and operational environment of this application. Because there will be a partnership between School of Electrical Engineering and Informatics (STEI ITB) as the research and application owner, and Telkom Institute of Management as business researcher and application service provisioner, then all the application service provisioning will be based on Telkom infrastructure and platform. With this scheme, consequently, all the 1st, 2nd and 3nd users layers (in Fig. 3) will utilize application services provided by STEI ITB and Telkom Institute of Management.

3. Conclusions and Further Business Study

This business perspective study has been conducted to obtain a different point of view from global and business point of view. This paper has described some preliminary feasibility study: legal aspect, environmental aspect, marketing aspect, technology aspect, management and resources aspect.

Further study would include the financial feasibility study and a more detailed feasibility studies.

References

1. Grimes, Anja. 2010. Influenza: Seasonal Flu and H1N1. Symptoms, Treatment, and Prevention. Continuing Education Courses for Healthcare Professionals, Wild Iris Medical Education, Inc,
2. Online news source: Maros, South Sulawesi, Bird flu widespreads in 10 regions. http://birdflucorner.wordpress.com/2011/07/.
3. Uyeki, Timothy M. 15 July 2009. Human Infection with Highly Pathogenic Avian Influenza A (H5N1) Virus. Review of Clinical Issues, Emerging Infections, CID 2009:49,.
4. Burhan, Erlina, Pulmonologist Dr. May 2008. Cardiorespiratory function and radiological changes in lung structure in Indonesian patients who survive highly pathogenic influenza A/H5N1 - a 3 years prospective study (Post bird flu function). Department of Pulmonology Persahabatan Hospital, Jakarta, Indonesia.
5. Online Medical Dictionary (http://medical-dictionary.thefreedictionary.com/breath+sounds)
6. Charbonneau G., Racineux J.L., Sudraud M. and Tuchais E.. **October 1983.** An accurate recording system and its use in breath sound spectral analysis. Journal of Applied Physiology vol. 55 no. 4 **1120-1127.**

7. Anderson K., Qiu Y, Whittaker AR. et.al. 2001. Breath sounds, asthma, and the mobile phone. The Lancet, Elsevier.
8. Auscultation, Wikipedia, http://en.wikipedia.org/wiki/Auscultation
9. Fluid in the Lungs – Causes and Treatment, HealthHype.com, Dr. Chris, http://www.healthhype.com/fluid-in-the-lungs-causes-and-treatment.html
10a. Assessing Lung Sounds, Youtube, http://www.youtube.com/watch?v=GP8Gqb9-saY
10. Easy Auscultation website, http://www.easyauscultation.com/
11. Dorland, Dorland's Medical dictionary: Respiratory sounds. Wikipedia, (http://en.wikipedia.org/wiki/Respiratory_sounds#cite_note-1#cite_note-1)
12. Journal Watch. November 2009. H1N1 Rapid Tests: Poor Sensitivity, vol. 12 no. 11
13. Voice Analysis, Wikipedia, http://en.wikipedia.org/wiki/Voice_analysis
14. Pulmonary tuberculosis, Medline Plus, U.S. National Library of Medicine, National Institutes of Health, http://www.nlm.nih.gov/medlineplus/ency/article/000077.htm.
15. K.W. Becker, Research into Adventitious Lung Sound Signals Originating From Pulmonary Tuberculosis Using Electronic Auscultation, Department of Mechanical and Mechatronic Engineering, Faculty of Engineering, Stellenbosch University, 2009.
16. WHO, Avian influenza – situation in Indonesia – update, January 19th, 2012, http://www.who.int/csr/don/2012_01_19/en/index.html
17. Dr. Moussavi, Dr. Hans Pasterkamp and Dr. Gina Rempel, "Respiratory and Swallowing Sound Analysis". University of Manitoba, (http://www.bme.ee.umanitoba.ca/?a=26)
18. Ria Lestari, Munawar Ahmad, Bachti Alisjahbana, Tjahjono Djatmiko. The Lung Diseases Diagnosis Software: Influenza Case Study, International Conference on Rural Information and Communication Technologi 2011, School of Informatics and Electrical Engineering, Institut Teknologi Bandung, November 2011.
19. Ria Lestari, Munawar Ahmad, Bachti Alisjahbana, Tjahjono Djatmiko The Lung Diseases Diagnosis Software: Influenza and Tuberculosis Cases Study, International Conference on Biomedical Science 2012, School of Life Science and Technology, Institut Teknologi Bandung, February 2012.
20. Ria Lestari, Munawar Ahmad, Bachti Alisjahbana, Tjahjono Djatmiko. The Lung Diseases Diagnosis Software: Influenza and Tuberculosis Case Studies in Cloud Computing environment, International Conference on Cloud Computing and Social Networking 2012, School of Informatics and Electrical Engineering, Institut Teknologi Bandung, April 2012, 26-27 April 2012.
21. Ria L. Moedomo, M.Sukrisno Mardiyanto, Munawar Ahmad, Bachti Alisjahbana, Tjahjono Djatmiko. The Breath Sound Analysis: For Diseases Diagnosis and Stress Measurement, International Conference on System Engineering and Technology 2012, School of Informatics and Electrical Engineering, Institut Teknologi Bandung, September 2012 (submitted).
22. Suliyanto, Dr. Studi Kelayakan Bisnis, Pendekatan Praktis. Penerbit Andi Yogyakarta, 2010.
23. Tom Chivers. Cough into your mobile phone for instant diagnosis. The Telegraph online, 9 November 2009 (http://www.telegraph.co.uk/health/healthnews/6530704/Cough-into-your-mobile-phone-for-instant-diagnosis.html).

K. Success Stories in Enhancing the Relevance of The Triple Helix Model

LESSONS FROM THE CURRENT JAPANESE TRIPLE HELIX MODEL

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Abstract
Since mid-1990s, the Japanese government has encouraged university-industry collaboration to foster innovations for economic growth. Learning from the American licensing model of technology transfer, Japanese Bay-Dole Act and TLO (Technology Licensing Organization) Act were enacted in late 1990s. In addition, the corporatization of Japanese National Universities (JNUs) in 2004 spurred their technology-transfer activities to obtain external funds. As a result, more than 50 TLOs has been established since FY1998, and also the number of patent application and licensed patents were increased at JUNs rapidly after FY2004. However, the licensing income has been stayed poor and some of TLOs were abolished. There are few evidences that the introduction of licensing model of technology transfer into Japan could contribute to innovation properly. Therefore, this study will try to clarify if licensing model of technology transfer work in Japan by analyzing the Japanese National University (JNU) patent. There are 20,485 applied patent, which invented by JNU's researcher(s) from FY2004 to 2007. 38% of them were applied by solely by JNUs and 52% were by JNU and Private Firms etc. In the Japanese Patent Act, jointly applied patents are not licensed to the third part without the consent of co-applicant(s). Hence, more than half of the patent invented by JNU researchers is not basically used for patent licensing. Consequently, JNUs and TLOs face difficulties in patent licensing under the current Patent Act.

Keywords: Technology Transfer, TLO, University Patent, Japan

1. Introduction

Since mid-1990s, the Japanese government has encouraged university-industry collaboration to foster innovations for economic growth. Learning from the American licensing model of technology transfer, TLO (Technology Licensing Organization) Act and Japanese Bay-Dole Act and were enacted in 1998 and 1999 respectively. The former promoted technology transfer activities from universities via accredited TLOs, and the latter could make it possible to entrusting patent rights from public research funds to trustees.

In addition, the corporatization of Japanese National Universities (JNUs) in 2004 promoted spurred their technology-transfer activities to obtain external funds from the private firms. As a result, most of JNUs started to run their own TLOs. Although there are more than 700 universities in Japan, approximately 100 universities including all the 86 JNUs could be regarded as research universities. Hence, it can be said that the corporatization has had a great impact on technology-transfer system.

According to a survey by the MEXT (Ministry of Education, Culture, Sports, Science and Technology), the number of the applied patent by JNUs rapidly increased just after the corporatization, and the number of filed patents by has been grown gradually from FY2004 to FY2010 as shown in Fig.1. The number of licensed patents by JNUs has been also increased from FY2004 to FY2010, while there has been poor in the licensing income of JNUs in Fig.2 (JST, 2012).

Fig.3 shows the number of newly accredited TLO and the number of abolished TLO (JST, 2012). Since FY1998 when the TLO Act was enacted, the number of accredited TLOs has been increased. However, some of the TLOs were abolished or bankrupted recently.

It does not seem that the introduction of the American technology transfer model into Japan has been successful so far, although it might be too early to evaluate it. There would be a structural problem behind the current Japanese technology-transfer system. Therefore, we analyze all the data of patent application by JUNs in order to clarify the issues on Japanese technology-transfer in this study.

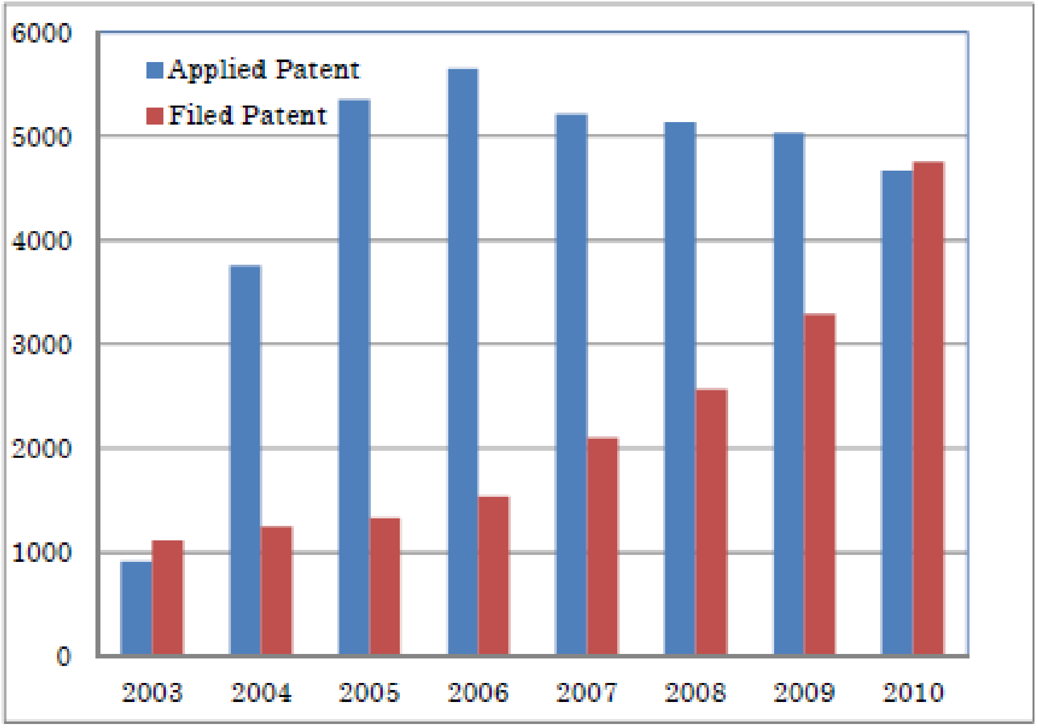

Fig.1 Applied Patents and Filed Patents by JNUs

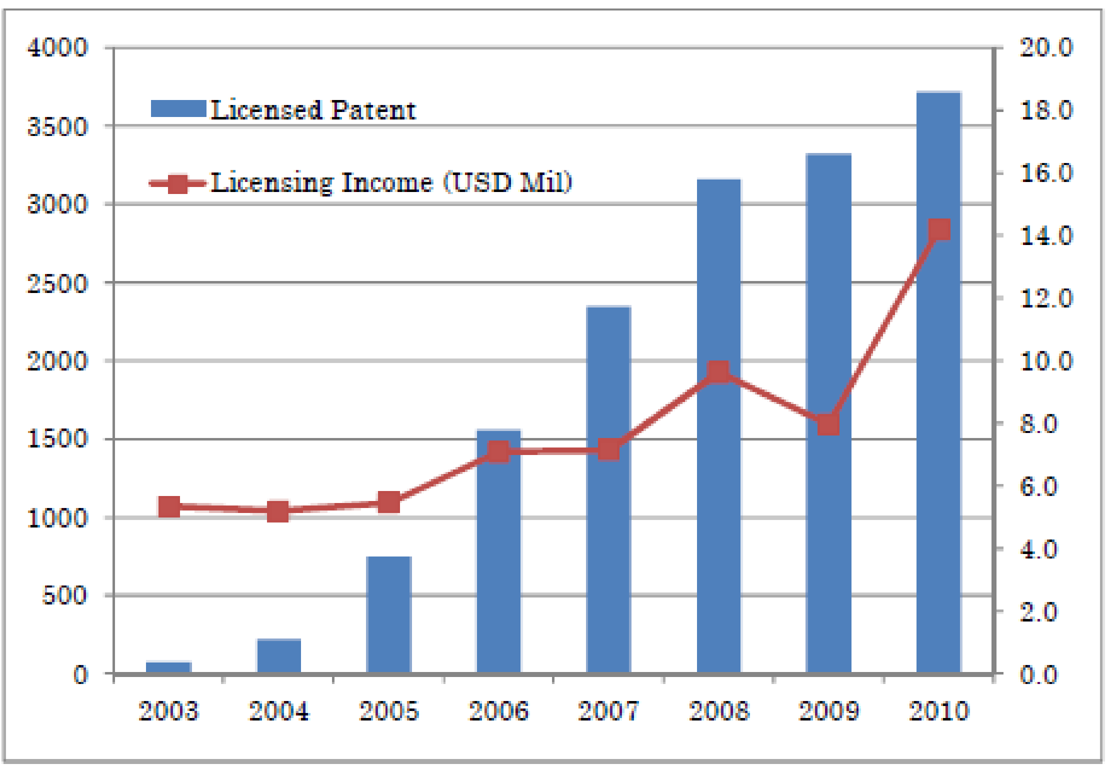

Fig.2 Licensed Patents and Licensing Income by JNUs

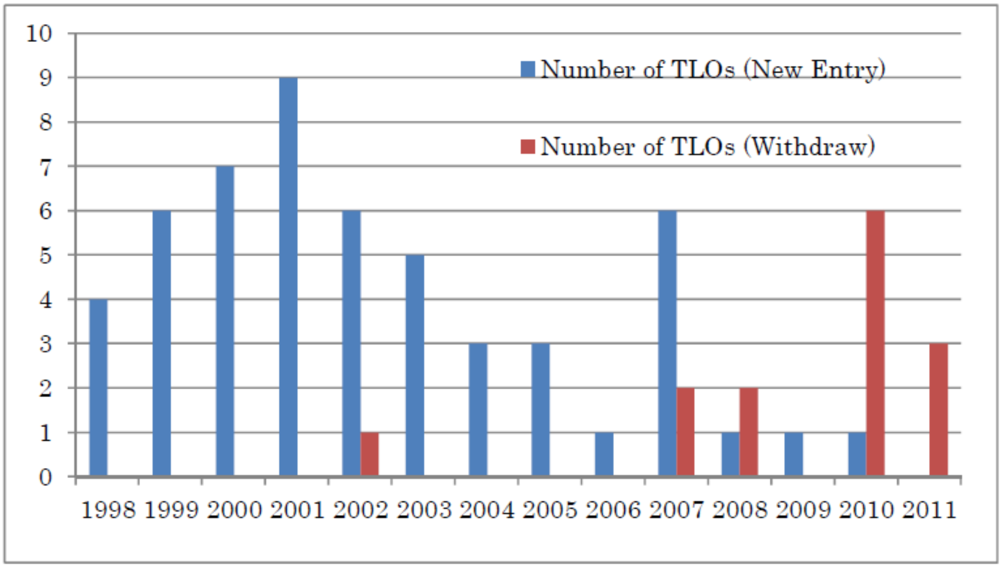

Fig.3 Newly Accredited TLOs and Abolished/Bankrupted TLOs

2. Data and Methodology

The data used for this study derived from the patent gazettes by the Japan Patent Office (JPO). First, the patents which application date are from Japanese FY 2004 to Japanese FY 2007 (from 1 April 2004 to 31 March 2008) are extracted, and secondly the patents whose inventors are JNUs researchers are obtained with the following conditions:

1. The patent whose applicant is JNU,
2. The patent whose inventors' address is JNU's address,
3. The patent whose applicant is TLO and whose inventor is JNU's researcher, or
4. The patent whose applicant is JST and whose inventor is JNU's researcher.

After the extraction of the data on the patents invented by JNUs' researchers, we collect additional information such as the affiliation and job titles of inventors, and finally construct a database on the patents invented by JNUs' researchers. Using the constructed database, we analyze JNUs' patents in terms of inventors and

3. Findings and Discussions

The patents, at least one of whose inventors is JNUs' researchers, are 20,485 from FY2004 to FY2007. Figure 4 shows proportion of applicants and inventors with different categories such as JNU, TLO, Private Firms (PF), and Public Research Institutes (PRI).

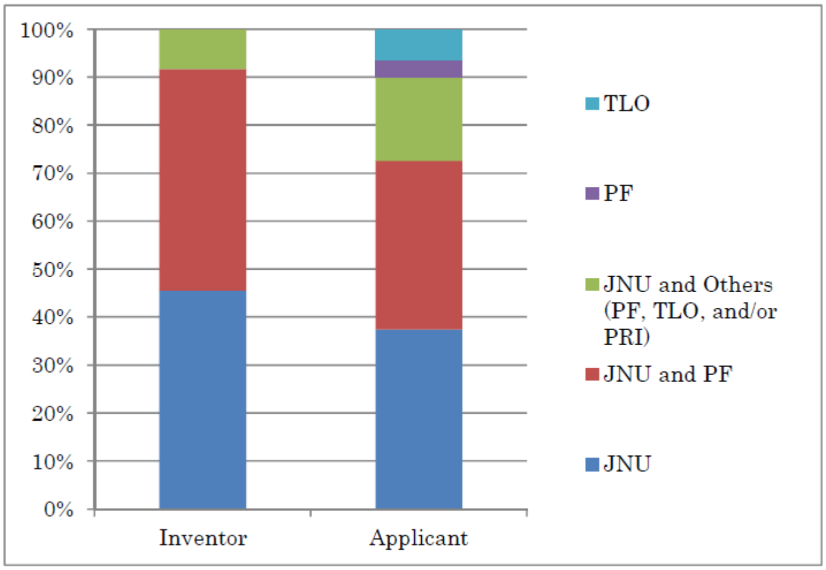

Fig.4 Proportions of JNUs' Patent with Different Inventors and Applicants

While 46% of the patents were invented solely by JNUs' researcher(s), 38% of the patents were applied by solely by JNUs. This means that a part of or all of right for patent application of 8% of the inventions solely by JNUs' researcher were transferred to non-JNU entities such as PFs and/or TLOs. Consequently, 52% of the patents invented by JNUs' researcher(s) were applied by JNU and others, and 3% and 6% were applied by PFs or TLOs respectively.

In the Article 73 of Japanese Patent Act (Law No.121 of April 13, 1959, as amended by Law No.63 of June 8, 2011), joint patent rights are defined below (MoJ, 2009).

(1) Each of the joint owners of a patent right may neither transfer his share nor establish a pledge upon it without the consent of all the other joint owners.

(2) Each of the joint owners may, except as otherwise prescribed by contract, work the patented invention without the consent of the other joint owners.

(3) Each of the joint owners may grant neither an exclusive license nor a non-exclusive license without the consent of all the other joint owners.

In the case of jointly applied patents (52%), JNU or TLO cannot license out to the third party without the consent of the other joint applicants. In other words, JNUs and TLOs could license out only the patent applied by solely JNU or TLO (44%).

4. Policy Implication and Direction for Future Research

Since private firms usually disagree to license out their applied patent jointly with JNU or TLO based on the Japanese Paten Act, JNUs and TLOs can only deal with the patent applied solely by themselves for their licensing activities. This would make it difficult for JNUs and TLOs to form a good patent portfolio, and to conduct technology-transfer activities focusing on patent licensing.

In a sense, it could be concluded that the introduction of American technology transfer model focusing on patent licensing into Japan has not worked well so far. If the Japanese Patent Act is amended to allow each of the joint owners to grant either an exclusive license or a non-exclusive license without the consent of all the other joint owners, the current situation might be changed.

Furthermore, if co-inventions by JNU's and PF's researchers are enclosed without utilization in the PFs who are one of joint owners, the situation would not be proper from the view point of public policy. Hence, we have to check if PFs utilize their co-inventions with JNU's researchers in our future research.

In conclusion, it is essential to take into account the domestic legal, social, economic constraints, when introducing technology transfer models from foreign countries.

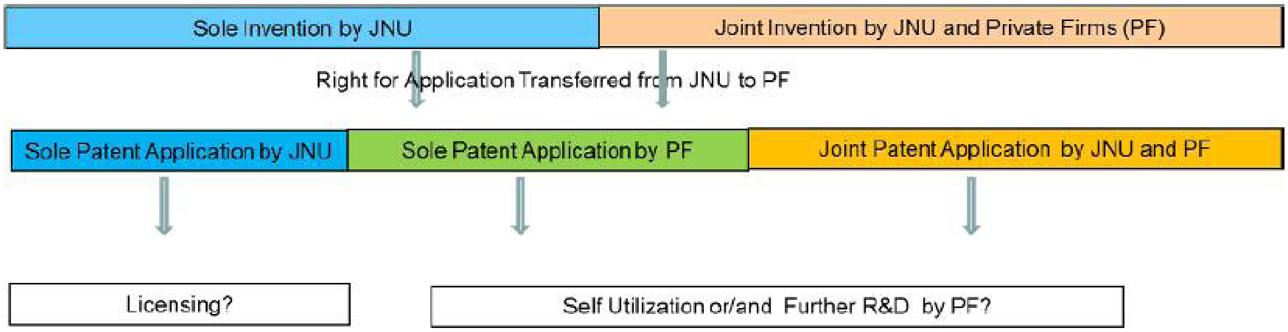

Fig.5 Utilization Flow of the Patents created by JNUs' researchers in Japan

5. References

JST (2012), Industry-University Cooperation Data-book 2011-2012, Tokyo, Japan Science and Technology Agency (JST)

MoJ (2009), Patent Act, Tokyo, Japan, http://www.japaneselawtranslation.go.jp, Ministry of Justice (MoJ)

6. Acknowledgement

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THE PROXIMITY BETWEEN ACADEMY, INDUSTRY AND GOVERNMENT: TOWARDS A MORE SUSTAINABLE DEVELOPMENT OF A BRAZILIAN OIL REGION

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Abstract
Collaboration between actors of Triple Helix can be identified as the basis for the development of main regions of innovation around the world. The model of interaction between Government, Academia and Industry is facing challenges for a better and greater transfer of knowledge, technology and innovation from universities to society and business. This article discusses the interactions of the Triple Helix actors for the technological development of oil and gas industry in Brazil. The study presents the current state of Triple Helix interactions in the sector and discusses the impact of physical and managerial distance between the institutions. We conclude by stating that current efforts to develop a “Triple Helix Region” must go beyond the goals of increasing technology to local industry. A long-term sustainable strategy must also be developed.

Keywords: Triple Helix; Campos Basin; Innovation; Oil and Gas; Brazil

KHONKAEN ONE STOP SERVICES: A THAI TRIPLE-HELIX-BASED PROJECT IN TAKING UNIVERSITY EXPERTISE TO SERVE PROVINCIAL ICT STRATEGIES AND PROMOTE SOFTWARE INDUSTRY

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Abstract
This article aims to look into a successful Triple-Helix based project in Thailand, namely “Khonkaen One Stop Services”. The project is under the coordination between Thai Software Industry Promotion Agency (SIPA), Faculty of Informatics, Mahasarakham University, Khonkaen provincial authority and several small and medium software companies. The initiative has started from the mission of SIPA to promote software industry in the northeastern of Thailand together with the mission of the Khonkaen provincial authority to extend the Information Communication Technology (ICT) usage to enhance citizen services and provincial administration tasks. To accomplish the objectives, Khonkaen province and SIPA have agreed to employ an ICT expert team from Faculty of Informatics Mahasarakham University to analyze and develop the core system. The know-how is then transferred to the regional software companies to learn and get extensive jobs from the local government sector. By applying the Triple Helix model of university-industry-government relations on the project, University, industry, government can coordinate successfully and fulfill their missions.

Keywords: Software Industry Promotion; Citizen Service Portal; G-market; Triple Helix

INNOVATION, INFORMAL ECONOMY, AND DEVELOPMENT: CASE OF ZAMBIA

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Abstract
The Zambian government has been building the national system of innovation (NSI) since the mid-1990s. But due to poor interaction between government, business and universities and the absence of pro-poor innovation policy instruments, the system has suffered serious shortfalls. This paper investigates the informal elements of the NSI policies and analyses the interactive dynamics of the innovation system to measure successes and identify failures. It proposes the triple-helix approach as a key concept to building an inclusive government-informal sector relationship that is framed on pro-poor policies for the alleviation of poverty through enhancing socioeconomic development.

Keywords: Development, national systems of innovation, Zambia, poverty, informal economy

Introduction

Innovation offers an important opportunity to address global poverty and developmental challenges (Kraemer-Wambula 2010; Torjman and Leviten-Reid, 2003). Yet, there is an increasing recognition that the simple emulation of rich country models or strategies will not fit the needs of developing countries, and that we need to work out innovation models bottom-up in developing countries (Lundvall et al 2009; Kraemer-Mbula and Wamae, 2010A; Andersson, 2006). As development strategies, rich country innovation models centre all too often on industrialization driven development, whereas many, if not most developing countries remain mainly rural and agricultural for a long time (Collier, 2008). When employing science, technology and innovation as development strategy, developing countries need often to address two sets of challenges: poverty and the long term up-grading of science, technology and innovation capabilities, (Nelson, 1993). Central for this paper is the observation mostly rich country originated innovation models are suited for formal economic activities, and address inadequately poverty, and especially innovation in the informal sector as credible and needed element for national systems of innovation. This challenge of innovation and informal sector, and particularly that of creating an environment of collaboration between business, academia and government as “The Triple Helix model” is examined in this paper through the case study of Zambia.

Triple helix approach (Etzkowitz and Zhou, 2006) centres often on industry-academia-government, but the apparent conditions of Zambian society and economy pose immediate problems. With over 50% of adult population being unemployed, the informal sector is the immediate social and economic context for the majority of Zambians (IMF, 2007). Yet, although government innovation policies make poverty reduction a priority, there is no attempt to include marginalized people of the information sector to innovation policy umbrella, neither in national strategy documents nor at the level of practical instruments (Mpuku and Zyuulu, 1997).
Indeed, Zambia’s national innovation strategies do not address the informal sector and the potential of innovation at grass-root level, where the need for pro-poor innovation is acute (Kraemer-Mbula, &Wamae, 2010B). This paper suggests a triple helix approach for government to embrace the informal sector through formulating and implementing policies that focus in alleviating poverty. The university-industry-government triple helix interaction model is not only crucial for developing innovations systems but also important in taking it aboard policy intervention. Equally, pro-poor policies for the informal sector activities need to be the centerpiece in creating opportunities for the poor whose voices are rarely heard at the top level. In the context of innovation and development, a triple-helix model that fosters interactions between key stake-holders in the informal sectors stands to make a huge contribution towards the improvement of livelihoods of Zambians at the bottom of the income and social pyramid.

This paper analyzes the Zambian national system of innovation with particular attention to the isolation of the informal sector from other key sectors for innovation, and develops perspectives to bring it under the agenda for national development. An inclusive informal sector policy, through triple-helix is suggested as to be the best model to cement the interactive dynamics between government on one hand and public sector on the other.

Economic development since independence

At the wake of Zambia's independence in 1964, the country was in the middle income group with per capita income of US$800. By 2002, the per capita income dropped to half the amount at US$405. The economy declined further in mid-1970s as a result of the 1973 oil crisis. The downward trend continued throughout the 1980s due to low copper prices on the world market. In 1991, a new government came into power with a national objective of transforming the economy through liberalization and privatization of key parastatal organizations. Although the government's agenda was sound, the national strategy didn't live up to its promises partly because of ill planned strategic policies.

Zambia is a resource based economy which still depends on mining activities as a source of its revenues. Since 1991, government implemented several versions of economic reforms, but they had very little impact on overall national development. The government however, ignored the importance of leveraging and integrating science, technology and innovation in various sectors of the economy to promote growth and development. In terms of the GDP growth, Zambia grew by 7% in 2010 driven and this was driven by in large China's high demand for copper but growth in agriculture. However, Zambia's economy couldn't sustain itself, further consideration were being explored to ensure that science, technology and innovation programs were part of the national development agenda (Siame, 2007).

Poverty in Zambia

Poverty in Zambia is serious and widespread. According to the 1994 Zambia poverty assessment report, about 69 percent of all Zambians households' expenditures per adult were below a level sufficient to provide basic needs. William Easterly pointed out in his seminal book, *White Man's Burden*, that Zambia was ranked seventh worst country in the world in terms of per capita growth rates between 1980 and 2002. During this period income per head decreased almost 2 per cent. In the same period, foreign aid amounted to 20 per cent of national gross domestic product, and the country had been receiving support from IMF for 53 years (Easterly, 2006). By pointing such failures across Africa and the World in reduction of poverty, Easterly has questioned the broader approach to donor driven economic and development planning, an opinion that can be echoed in national innovation system efforts in developing economies as well.

In all given records, this is a serious problem and it requires agent strategic measures on national level to tackle the problem. Table 2 shows the poverty gap in both rural and urban towns corresponding with the total population from 2001 to 2005. Although some of the data is not available, the data available clearly shows that in the periods of 2002 and 2004 the poverty gap is quite high in rural districts than in the urban towns.

Table 2. Zambia Poverty Gap for 2002 and 2004

Year	**2001**	**2002**	**2003**	**2004**	**2005**
Population, total	10723 651	10 972 245	11 218 960	11 472 278	11 738 432
Poverty gap at urban poverty line (%)	..	19	..	22	..
Poverty gap at rural poverty line (%)	..	31	..	44	..

Source: World Bank Indicators (2010)

Zambia's agricultural and industrial sectors have no strategic innovation policies that aim at promoting development in the clusters and therefore creating employment. This means that these sectors are not contributing to sustainable growth at optimal level. Unless these clusters are developed with a proper approach, poverty will continue to be the biggest problem faced by the government. While foreign investment is actively flowing into the country, tangible benefits would only be realized through balanced concession. It is the duty of governments to commit themselves in good planning and devising strategies that are aimed at sustainable growth. For example, the health sector continues to be deprived of professionally trained manpower because most of the skilled personnel leave the country for better prospects abroad (Ngulube et al., 2004). However, government has a huge task ahead as building capabilities and developing strategic plans should be prioritized in order to optimize science and technology diffusion. These and many more aspects need to be high lightened as driving forces to address socio-economic imbalances.

Methodology

The study analyzed and reviewed different research papers previously done on Zambia, including national policies, reports and other empirical findings. In order to support and gather strong evidence, a field research study to Zambia was arranged and interviewed leaders from government and public institutions that are involved in policy making especially the science and technology policy. A total of 10 leading policy makers were interviewed and their opinions were analyzed to help in drawing conclusions about the effectiveness of Zambia's situation in innovation systems and the impact on national development. The approach adopted has been qualitative.

The interviews were tailored for various public institutions with regard to their roles with government over the implementation of STI policy, the national innovation activities and informal sector innovations programs. The responses were analyzed by comparing opinions/views from respondents from both sectors. The conclusion drawn was based on the statements produced and on what the respondents found to be the reason behind poor interactive dynamics within the national system of innovation.

Analysis of the Zambia Science, technology and innovation system

Science and technology policy (S&T) has become an important part of national development worldwide. In the case of Zambia, the absence of a national science and technology policy since independence in 1964 is believed to have attributed to under development, poor economic performance and high incidences of poverty. In the beginning of 1964, S&T was not one of government priorities in national development processes. Instead, all national development activities were implemented through various micro-economic programs. Some of the objectives of these programs were to increase industrial production for various key products and help in the creation of new industries. However, the program did not achieve the desired goal due to lack of focus and coordination. Furthermore, adoption and diffusion of technology was poor and this proved difficult to sustain industrial development on long term. Zambia has two major economic sectors; Mining and Agriculture. Between 1964 and 1991, the Zambian economic and industrial performance deteriorated which consequently brought hardship with high poverty level on majority of Zambians (NPST, 1996). As industrial performance became uncompetitive, many of local industries closed and followed by protests across the country. In responding to the deterioration of the economy, the government realised that the need for transformation was inevitable. The government recognised science and technology to be central to creating wealth and improving the quality of life. A first science and technology policy framework was drafted and released in 1996.

The situation of science and technology in Zambia can be described as relatively underdeveloped (Fifth National Development Plan, 2006-2010). The majority of Zambians live in rural areas and agriculture is the main source of livelihood. But since 1964, the agricultural sector has not been fully exploited. According to the Poverty Reduction Strategy Paper (PRSP) of 2002-2004, agriculture is recognized as a key for poverty reduction efforts, and one of the best ways to expand opportunities for poor to improve their livelihoods. Therefore PRSP gives priority to agriculture. In absence of national strategies in adapting science and technology, they have been unlikely to increase crop yields, produce new scientific knowledge, and sustain fertility farming land. In essence, science and technology can contribute strongly to national productivity and economic growth for Zambia just as is the case in developed countries. The government realized that in order to create growth in the economy, S&T need to be part of the national development programs. Consequently, this followed the drafting of the 1996 S&T policy document. Zambia's three decades without S&T national strategy is an issue that needs to be high lightened. The fact that Zambia has depended on a few sectors in the past three decades, is identified as one of the contributory factors for the country's lack of development of the science and technology sector and subsequently reduced innovation (FNDP, 2006).

Science and Technology Policy of 1996

The Ministry of Science, Technology and Vocational Training (MSTVT) drafted the first S&T policy in 1996 as a measure to address the deteriorating economy and industrial performance in Zambia. Since independence in 1964, Zambia did not have a national policy on science and technology and did not recognise the important role S&T played in national development processes. The National Science and Technology Policy of 1996, was designed to embed S&T as part of the culture in key sectors to promote competitiveness. The ministry's assertion in the S&T policy of 1996 is admitting that the absence of an economic policy framework that includes S&T aspects created a vacuum in spearheading development key sectors of the economy (NSTP, 1996).

The 1996 National Science and Technology policy's (NSTP) mission can be summarised as having targeted the improvement of the quality of life for all Zambians; to promote and exploit science and technology as an instrument for developing an environmentally friendly indigenous technological capacity in sustainable socio-economic development. Concise as it sounds, the mission does not outline a structural approach of how various components can be implemented sustainably. The main problem of the 1996 S&T policy document was that it was over-ambitious, given that the instruments and infrastructures fell short of capacity, and government was underfunded and lacked resources. While the emphasis on promoting indigenous knowledge is welcome, the document does not provide a mechanism of how this could have developed. The 1996 S&T fell also short of addressing high poverty level, as well as lacked a pro-poor approach.

Challenges and current situation of the 1996 S&T Policy

Currently, the 1996 S&T policy document is still being used as a referral document and it also provided background in the drafting the revision of the 2009 STI policy that incorporated the innovation aspect. However, as mentioned in the 1996 S&T policy, one of the objectives was to impact on economic growth through creating wealth and jobs by supporting the creation of Micro, Small and Medium Enterprises (MSME), but there were a lot of shortcomings, among others; lack of support mechanism which even today, the success rate of MSMEs is relatively low (Mwenechanya 2011). Furthermore, lack of financial instruments to facilitate technology diffusion, transfer, innovation and commercialisation was the biggest challenge for government. For example a quote from the S&T policy of 1996; *Says that the policy focused more on restructuring the institutional framework in the science and technology sector by separating policy and advisory functions from the research and development function and creating of management board. But at the same time, admits that very little is covered in terms of rationalisation of funding mechanisms to research and development*.

Science, Technology and Innovation Policy of 2009

The National STI Policy of 2009 (NSTIP, 2009) was developed as a revision of the S&T policy framework from 1996. Its key feature, when contrasted with the old framework, was the introduction of innovation as one of the key elements of national strategy. The strategy outlined as its key objectives also to strengthen national science and technology framework, and forge closer links between the programmes of the research and development, as well as prioritised various sectors in national wealth creation, productivity and competitiveness. The 2009 policy was launched within the broader national government vision for 2030, which envisioned the significant role that science, technology and innovations should play in improving socio-economic conditions of Zambia. Importantly, the 2009 strategy was also a direct outcome from the 2006 five-year national development plan, which was later published as in the IMF country report and Zambia poverty reduction paper. (IMF 2007; FNDP 2006).

In both the S&T policy of 1996 and STI policy of 2009 recognises the need to provide incentives to facilitate technology, diffusion, transfer, innovation and commercialization but they do not explicitly outline how the instruments for incentives can be developed. While provision of incentives is crucial, lack of accessibility to modern and appropriate technologies has always hampered progress for MSMEs to achieve significant growth. Promoting innovation in small scale business and private sector as a whole is extremely important for the country to achieve a strong economic growth. For example, the STI policy of 2009 mentions of the creation of Youth Inventors Fund to support youth developing innovative ideas that would be converted into technological products. In essence, the STI policy of 2009 is supposed to drive innovation from grass root to full commercialisation.

According to the 2009 STI policy, the institutional structure of Zambia needs a new arrangement that would support a smooth implementation of the policy. It outlines that STI activities should cut across all sectors of the economy and ministerial portfolios but provides no operational framework on long term. Similarly, successful implementation of the STI policy requires appropriate arrangements of institutions. Zambia's institutional arrangement has been identified as weak and ineffective (S&T 1996: STI 2009). Institutions should be structured to facilitate the implementation of policies while cabinet provides the overall direction and guidance. Du Plessis (2006), contrasts institutional change in Zambia to that of Europe, by saying the lack of time to adapt to a new economic and political environment needs to be highlighted.

Challenges and current situation of the 2009 STI Policy

The Ministry of Science, Technology and Vocational training (MSTVT) is responsible for implementing STI policy framework. As ministry with the government mandate, its position is to lead all sectors in fostering the adapting of science and technology at national level, but efforts to lead have a lot of short comings. There has been growing criticism from stakeholders towards the ministry in its failure to effectively map out policy implementation strategies that are result oriented. According to the evidence gathered during the interviews conducted in the 2011 field study in Lusaka, Zambia by (authors), the MSTVT and stakeholders within the science and technology system were of the view that lack of information amongst the actors was hampering progress. Also both science and technology policy documents admit that Zambia's science and technology system is being poorly coordinated and suffers from weak linkages between government and other key sectors and institutions. (S&T 1996; STI 2009).

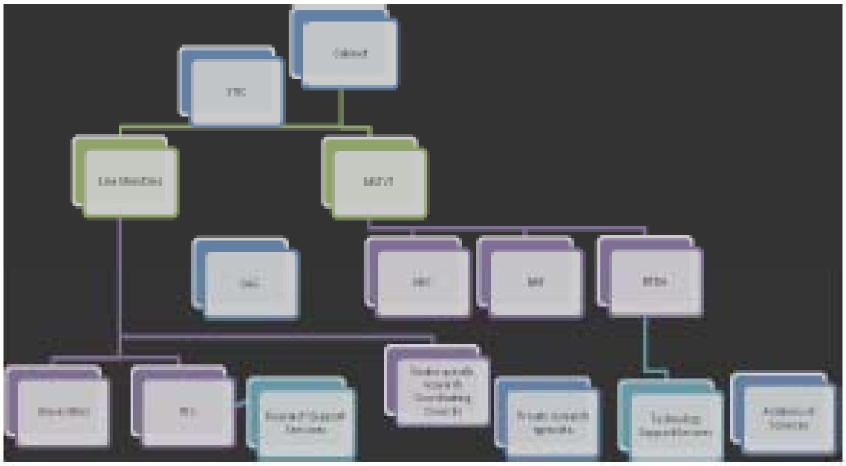
Fifth National Development Plan of 2006-2010 mentions about the importance of science and technology as fundamental in generating new scientific knowledge and implementing of existing technologies to adapt to local circumstances. But at the same time recognises the challenge of building a mass human resource base in science and technology that can only be realised by attracting more investments in this area.

Informal sector and the Zambia national system of innovation

While the Zambia NSI should be considered the most important entity for conceptualizing innovation systems due to the importance of country-specific interactions in creating a climate for innovation, the role of indigenous knowledge needs to be acknowledged too. In fact most innovation activities in the informal sector are in some ways derived from indigenous knowledge which unfortunately is not explicit in the innovation system frame work (Kraemer-Mbula and Wamae, 2010).

For a developing nation like Zambia, an emphasis on SMEs development is important because it does not only contribute to economic growth but helps stabilize the society by creating jobs and further improving the welfare. Building of a viable NSI policy that addresses national needs is a vital step that can guide the country to sustainable economic growth. The major directions of the present NSI policy attempts to implement STI across all sectors of the economy and ministerial portfolios. Figure 4 shows the STI institution framework that has four levels and the cabinet has authority over universities and research institution. The framework is a top-bottom hierarchy where government has a stronger say and in this case mandates how STI must be applied. However, the linkages and interaction pattern are vertically aligned and knowledge flow follows in the same links.

Figure 4. STI Institutional Framework



Source: MSTVT (2009)

Developed countries are able to generate and extensively apply science and technology so as to ensure their development and global competitiveness (OECD, 2007). They have already created the necessary preconditions for the generation, promotion, diffusion and application of scientific and technological knowledge whereas, in the case of many third world countries, the application of this knowledge in the realization of their development objectives is at a very low level (Toivanen and Ponomarivo, 2011). This in turn, is followed by socio-economic problems in Zambia that are deeply rooted, largely due to the absence of well-established scientific and technological base to generate and/or select, adapt and innovatively apply scientific and technological knowledge to solve development and environmental problems. For long time, both universities and research institutions have been chronically underfunded and government has not been able to develop instruments of how to fund institutions and other sectors (Konde, 2007). Overall, this has had negative implication on the flow of knowledge amongst key actors. While it remains logical that universities and research institutions should function as sources for production and diffusion of knowledge, Zambia's case is rather different (UNCTAD (2006).

Innovation-led development implies that the way in which a region harnesses its assets is more important, in many ways, than the initial ingredients with which it starts. For example, Zambia has abundant fertile land that is suitable for growing various food crops, but it is underutilized. Science and technology can play a huge role in addressing the low yielding farming methods such as developing adaptable and or drought resistant crops that contribute to high yields. Improving farming methods through adapting science and technology can go a long way in alleviating poverty that is affecting much of Sub-Saharan Africa. One way to proceed in the search for 'innovation niches' is to determine the requirements that is the goods, services and/or skills of the major clusters in the local economy and to become a supplier to these clusters. (Torjman and Leviten-Reid, 2003).

The concept of national system of innovation, is supposed to function on strong pillars of linkages and interaction amongst the actors involved in innovation performances through effective exploitation of science and technology knowledge. In a country like Zambia, science and technology capacity building and applications needs to be integrated with the overall national development plan (Lundvall, et al., 2009). While Zambia has the necessary infrastructure, the NSI structure appears to be relatively weak. Actors involved, do not relate to each other in enhancing a system of knowledge creation. It is important for the government to undertaking a review on the functions and interactions of the stakeholders of the national system of innovation. It lacks a participatory policy, adoption and implementation including legal, operational and financial issues that make the national system of innovation more relevant, effective, efficient and sustainable.

Zambia's organizational structure of the national system of science and technology is highly influenced by the government. Instead of being based on the decentralized governance structure of the nation to ensure active participation of the federal and regional stakeholders, all decisions falls within the cabinet (MSTVT, 2009).

Government-informal sector interaction in Triple-Helix

It is difficult to estimate the actual contribution of the informal sector in Zambia, and Sub-Saharan Africa as whole, to national economy. Despite of its central importance, we have currently very limited understanding of the role it plays, and even less so about how innovation plays out in the informal economy. Sub-Saharan Africa has the highest incidence of poverty and high unemployment in the world, and people have to survive and make a living often in highly challenging conditions, forcing or inducing them to engage in the informal sector to trade in goods and services. Yet, probably due to the political sensitiveness related to the informal sector, most Sub-Saharan countries lack explicit or reliable structures and instruments to support business, entrepreneurship, innovation or other knowledge based economic activities in the information sector, although innovation has a contribution to make in the sector.

Zambia has a lot of activities in grass root innovation that exist in the private sector. The informal sector is predominantly found in markets in the metropolis of Zambian towns. The informal sector provides more employment to a larger segment of the population than the formal sector. But despite this, not much has been done to improve this sector, neither is there much organized effort to research and analyze its contribution to the economy. The structures that have been put in place over the years are not sufficient to allow businesses to thrive especially in locations such as markets. This is further weakened as the new STI policy of 2009 appears to be insufficient in its approach to informal sector, for example in mobilizing entrepreneurship at the base of the pyramid, among other things.

More needs to be done to help transform the entrepreneurial activities carried out in markets into viable businesses, fully integrated into mainstream economic life. From the look of things, the ruling class has no concept of what life is like for people in the informal sector, who have been systematically dispossessed of the opportunity to have decent work and dignity as human beings. Economic reality has only made linkages and main communication channels between university and industry. Although government has drafted a new SME policy, it is nonetheless lacking a developmental strategy in improving conditions but also drifting the sector into the mainstream economy.

The unemployment rate in Zambia is about 50%, suggesting very high participation in the informal sector in national economy (IMF 2007). When one analyzes Zambian economic structure, it also suggests high participation in agricultural, totaling almost 20% of GDP (Figure 3),. This reconfirms how important it is for country's national innovation system to build a strategy for innovation in the agriculture sector. As more and more people remain excluded from the security of waged or salaried employment, the number of workers in informal employment keeps increasing (Andersson, 2006).

In the Zambian context, local innovation is predominate in the informal sector since it is the biggest employer for both skilled and unskilled work force, and it is extremely important in addressing poverty. Successes, however, can be described more in terms of the impact of products and services produced from local innovation that generate income for people involved in innovation activities.

Table 3 GDP Composition by Sector 2010

Zambia	Agriculture	Industry	Services
(%)	19,7%	33,7%	46.6%

Source: CIA-WorldFact book

Zambia has high poverty levels and hunger is one the biggest problems that affect mostly rural people. However, efforts by industry-government to break the bondage of the people from alarming poverty levels have not been attainable partly due to chronic scientific and technological deprivation (Banerjee and Duflo, 2011). While local innovation has significant contribution mostly in the informal sector, high poverty incidences still continue to be high. Although this paper is suggesting the creation of linkages of government-informal sector relationship, emphasis however, is on government to build dialogue with the informal sector. But it may not be right to say, that alleviation of poverty is failing, on the contrary, it is rather slow and requires more effort in investing in various programs that address socioeconomic factors, among other bridging government-informal sector relationship.

Local innovations in the private Sector

The role of local innovation in raising growth can be seen as an "indirect" albeit extremely important, as an effective innovation on wellbeing. There are many areas where science and technology advancements could directly improve the lives of millions of people, through local product innovation and services. Zambia's local innovation is born in the informal sector although it rarely comes to light in the mainstream economy. However, local innovations have bondage with the private sector through small-medium size entrepreneurship development (Siame, 2007).

For long period, the official policy has hoped for knowledge spill-overs from the heavy mining industry cluster and enhancing linkages between them, a hope that made visible strategy also in the 2006 published 5th National Development Plan, which built on the 1995 launched Zambian mining policy in arguing that the large-scale mining sector has an important role to "facilitate skills and knowledge development in order to increase the stock of human capital" and "facilitate the development of the service input sector, downstream processing, and beneficiation industries and centres of knowledge creation and innovation". The paper also suggested that large-scale mining could boost small scale mining, and thereby have wider social and economic impacts in the Zambian society. (FNDP 2006, 65-66).

Yet very little of this has been accomplished over the past years, echoing perhaps known disappointments with large-scale industrial developments in poor African countries, as suggested by Brolen, Wilska and von Bonsdorff in Mozambique (2007, Brolén K, Wilska K, von Bonsdorff M). As noted often in the official planning documents, it is especially the small scale producers who have difficulties to benefit from implemented knowledge support activities. These types of problems are not limited to the mining sector, but are characteristic across domestic industries, such as agriculture, handicraft, building, and so on. Thus the Triple-Helix linking the informal sector arises, making for government to balance between economic development and alleviation of poverty. The 2006 National Development Plan, which was sponsored by the IMF, noted difficulties to mobilize knowledge and skills in support of production in textiles, fisheries, live-stock, and other small-scale producers sectors (FNDP 2006, 46-57).

Whereas the official, IMF and World Bank guided, national plans argue for synergies between large scale industrial sectors and small scale producers, the Zambian national science and technology strategy (2009) has emphasized the lack or insufficient linkages between knowledge institutions and economic organizations. The weak networking of national innovation system led, it argued, public research organizations to duplicate research efforts. The strategy also identified that the private sector barely participated in national public research and development efforts, undermining the contribution of knowledge in national economy and emphasizing the lacking links to scattered small-scale producers. (MSTVT 2009)

Findings and Interpretation

The findings from our field research study in Zambia give us strong evidence on how weak interactive dynamics of Zambia's Triple-Helix model of University-industry-Government are. This is summarized to Government's failure to play a leading role in implementing science, technology and innovation policy to spearhead economic development. The finding also reveals the government's neglect of the informal sector is partly to blame for high incidence of poverty more especially in the urban area. The governance model of national systems of innovation needs is not adaptive of the local conditions instead it appears to imitate western models of innovation systems which seems to work. Although efforts in building a proper NSI and triple helix models are envisaged to bring active participation of all stakeholders, the actual interactive dynamics in developing countries fall short of truly inclusive approaches that address the needs of marginalized people. Typically, such shortcomings are ascribed to lack of strategic measures in policy implementation to strengthen social capital, for example through arresting trust that is required for good and close interactions. (Utz and Dahlman, 2007).

Furthermore, it suggests that there is further need to iron out the conceptual framework of adaptation of governance models of national systems of innovation and triple helix in development context that bridges government-informal sector relations. The same need of strong framework in guiding adaptation to local social, cultural and ethnic reality is needed at the level of policy agencies and implementing actors (Brolén, Wilska, von Bonsdorff, 2007).

Conclusions

Innovation has a great potential to lift the living conditions and prospects of the world's poor, but this cannot be achieved through traditional, narrow science and technology centered innovation policy and systems. The Zambian national innovation systems emulates a model of national system of innovation, but its essence, interactive learning and circulation of knowledge, remain poor or absent, and lend little support to the processes of innovation. There are issues at almost all levels of the national system of innovation, at the level of governance, public research organizations, and industry-academia cooperation.

Although overwhelming majority of Zambians live and operate within the confines of the informal economy, there are hardly any direct policy strategies or instruments to address the high poverty levels. It is therefore of paramount importance that an inclusive informal sector within a Triple-Helix is advocated. The triple helix model would take this process further by looking at the dynamic nature of knowledge and to institutionalize sources outside the economy, in particularly, the university, as a source of knowledge for innovation and national development.

Informal sector and pro-poor innovation policy instruments are absent from the present national system of innovation strategy. Although overwhelming majority of Zambians live and operate within the confines of the informal economy and poverty, there are hardly any direct policy strategies or instruments to address them. The objective of producing knowledge spill overs from large scale and foreign direct investment funding mining operations, as well as from large scale agriculture, to small scale producers, are recognized in policy planning, but there is hardly any real progress in delivering on such expectations, and it is difficult identify any concrete instruments addressing such needs.

Lack of funding remains an issue for African innovation. In the context of Zambia, a country with abundant natural resources and home to world's largest mining operations, it strikes the common sense that there is no mechanism to direct money into investments in knowledge economy, and certainly the issue of securing funding must be elevated within the scholarly discussion on innovation and development.

Finally, it is obvious that there is huge gap between the outspoken objective of harnessing science, technology and innovation to fight poverty and the absence of concrete policy instruments and measures delivering that. Zambian policies repeatedly emphasize how critical national issue poverty is, and how critically the national system of innovation must address this. Yet, there are hardly any concrete measures to be identified, and furthermore the record on poverty alleviation in Zambia remains weak. Evidently, the academic community considering conceptual framework on inclusive innovation and pro-poor innovation policies must spend more effort in inventing and developing real-world concrete methods and actions to harness innovation in benefit of the poor.

References

Andersson, T (2006). Ethiopia: *Innovation and Growth in International Comparison*. IKED paper.

Banerjee***, A and*** Duflo***, E (2011).*** *Poor Economics*: A Radical Rethinking of the Way to Fight Global Poverty. PublicAffairs.

Brolén K, Wilska K, von Bonsdorff, M. (Eds) (2007). *Aid for Trade: from policies to practice:* The case of Mozambique, Tanzania and Zambia. Helsinki: Ministry for Foreign Affairs.

Collier, P (2008). The Bottom Billion. *Why the Poorest Countries are Failing and What Can Be Done About it*. Oxford: Oxford University Press 2008.

Du Plessis, S. (2006). *Institutions and Institutional Change in Zambia*, Stellenbosch Economic Working Paper: 16/06: University of Stellenbosch.

Easterly, W (2006). *The White Man's Burden*. Why the West's Efforts to aid the rest have done much ill and so little good. Oxford: Oxford University Press.

FNDP (2006). Fifth National Development Plan 2006-2010, Ministry of Finance and National Planning. Lusaka, Zambia.

Global Research Alliance (2009). GRA 4000 – *Leveraging STI to empower the global poor*. Global Research Alliance, Pretoria.

IMF (2007). Zambia: *Poverty Reduction Strategy Paper*. IMF Country Report No. 07/276. International Monetary Fund, Washington, D.C.

Kraemer-Mbula, E and Wamae, W. (2010). *Innovation and the Development Agenda*, OECD Innovation Strategy.

Konde, V (2004). Internet development in Zambia: a triple helix of government-university-partners. International Journal of Technology Management 2004 - Vol. 27 (5) pp. 440 - 451

Lundvall, B Å, Joseph K J, Chaminade, C, Vang J (2009). *Handbook of Innovation Systems and Developing Countries*. Building Domestic Capabilities in a Global Setting. Edward Elgar.

Malerba, F & Manil, S. (2009). Sectoral *Systems of Innovation in Developing Countries*: Actors, Structure and Evolution. Edward Elgar 2009, 4.

Mpuku, H. C and Zyuulu, I. (1997). *Contemporary Issues in Socio-economic Reform in Zambia*. Ashgate Publishing. England.

MSTVT, (2008) *Ministry of Science, Technology and Vocational Training*. Republic of Zambia

Nelson, R. R. (1993) (ed). *National Innovation Systems*: A Comparative Analysis. New York: Oxford University Press.

NPST (1996). Science and Technology Policy of 1996. Republic of Zambia.

NSTIP (2009). Science, Technology and Innovation Policy of 2009. Ministry of Science Technology and Vocational Training. Zambia.

Ngulube, T., J. Mdhluli L., K.Gondwa and C.A Njobvu (2004). *An assessment of the impact of Health Centre Committees (HCCs) on equity in health and health Care*. CHESSORE Lusaka Zambia

OECD (1997). *National Innovation Systems*. Paris.

PRSP (2002). Zambia Poverty Reduction Strategy Paper: 2002-2004. IMF

Siame, K. (2007). *Zambia Private Sector Development reform Program* (PSDRP)

Lessons Learned Based on Institutional Architecture and Design of the PSDRP. Republic of Zambia.

STI Policy (2009). *Science, Technology and Innovation Policy*. Final Draft.

Ministry of Science, Technology and Vocational Training. Republic of Zambia.

Toivanen, H & Ponomariov, B. (2011). *African Regional Innovation Systems*:

Bibliometric analysis of research collaboration patterns 2005-2009, Scientometrics, forthcoming.

Torjman, S and Leviten-Reid, E (2003). *Innovation and Poverty Reduction*, published

by Caledon Institute of Social Policy, Canada.

UNCTAD (2006). *Investments Policy Review Zambia*. United Nations.

Utz A and Dahlman C (2007). *Promoting inclusive innovation*. In: Dutz AM (Ed), Unleashing India's Innovation. Towards Sustainable and Inclusive Growth. Washington, D.C., The World Bank.

World Bank (2010). *Data Bank*. Available in: http://databank.worldbank.org/ddp/home.do