University's Portfolio of Industrial Connections in a regional context: A functional cross-institutional approach innovative process: New insights from Japan

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Abstract: As URI have come to be the center of knowledge production in regional innovation systems, state and local governments who are the main supplier of research fund, have laid emphasis on patents, licenses and start-ups as a concrete measure of economic value arising from the research investments. A series of policy reforms in Japan, where previously URIs were known to focus on the training of highly qualified personnel and the production of knowledge (as seen on the number of patent registrations) as their primary economic role, were introduced that encourage greater university participation in commercial activity. This trend is captured in this paper through narrative case approach of the Kyushu University as a major player in the regional innovation system. Despite similar amounts of research funding and human resource in science and technology (HRST) compared with other universities in Japan, the Kyushu (West Japan) region produces more startup companies vis-à-vis the number of patents registered. The dynamism of Kyushu university portfolio lies in the fact that they have taken a comprehensive inter-disciplinary and cross-institutional approach to formal and informal technology transfer, support for entrepreneurship and a deliberate effort in participating in regional economic development projects..

Key words: University-Industry-Government relationship, Technology Transfer, entrepreneurship, innovation

1. Introduction

A brief historical look at URIs in the United States and their portfolio in the innovation process will provide a conceptual framework for the direction of this paper. While the American context is different, there is value in examining the experience of these URIs as a source of ideas and practices for discussion with URIs in Japan

In the beginning of the 19th century the United States of America (USA) based on the vision of "scientific agriculture" (Etzkowitz, 2002) had already engaged university on research and training in agriculture, the major American industry at that time, and as early as 1867 beginning with the Hatch Act to the Land grant, universities could receive research funding and technology transfer through liaison structures. This led the USA to become a world leader in agriculture. This also set the pace of what was to be a long history of university involvement with industry and government. Even though federal funding played and important role in university research, the financial stringencies faced during the depression in the 1930s and the unpredictable government funding as witnessed with laws passed in the 1970 to only fund state universities, put pressure on universities to find other ways of funding. However it was not until the Bayh-Dole act that universities took more of an entrepreneurial role in strengthening industry ties in order to commercialize their inventions.

In Japan after the Meiji restoration, there was an Imperial University with a school of engineering, it did not have any western connections or collaborations, but there was some form of Academia – Industry relations that existed between the university and the established companies. (Watanabe, 1991) After World War 2, Japan embarked on efforts to enable it becomes an economic superpower. In so doing Japanese industry with the help of special government agencies looked up to western nations in regard to knowledge for industrial development and in the same way the universities focused on the west to advance standard of education This drew a parallel between University and Industry with industry regarding university as a supplier of qualified human resource. (Watanabe et al, 1991) Japan's deep-seated preoccupation with its economic security led it to craft strategic policies that stimulated both industry and a local market which led to economic prosperity that took away attention of the Japanese from the ongoing revolution of academia-industry relationship taking shape in the western world and in China. It was not until the bubble burst that Japan began to realize the importance of this

alliance and stated formalizing institutions for academia-industry relationships from 1998.

University based Innovation

Based on the above narratives we can see that university-industry interaction of these nations have evolved from different trajectories; however they have converged on the sole objective of enhancing university-industry relationship with the goal of creating and diffusing innovation especially through commercialization. In order to understand the importance of the social dimension, a two level analysis is introduced, the first level looks into the conventional structural portfolios that universities posses in order to commercialize (includes technology transfer) their research, Kanai and Ishida refer to this as the enabling structural or physical factors of developing new businesses (2000). The second level analysis looks at the functional portfolio through the institutional set up that Kyushu university has drawn that build entrepreneurship support infrastructure while building networks that enhance the smooth transfer of technology form URI to industry

Table 1 University Economic indicators.

	External funding	Allocation per professor	特許取得 (98-07)	Patent disclosure	Start ups
Kyushu	10,000	6.8	26	265	55
Kyushu Technical		3.47	33	148	45
Nagoya	7,770	6.03	127		28
Nagoya Technical	1,627	5.53		294	14

Comparative table of Kyushu and Nagoya

1. Structural Portfolio

1.1 Government Legislation and Research funding

Even though not directly included in a university's portfolio for industry connection, legislation has played an important role in technology transfer (TT). In the United States the Bayh-Dole Act was made with the goal of curbing on the free-rider effect by granting universities, clear title to the invention done through federal assistance. The act rationalized and legitimized university patenting therefore fostering greater collaboration between University and industry TT. Its success was transmitted to the Japanese TT mechanism where a similar effect was realized.

Since the mid-1990s, the Japanese government has instituted a series of reforms designed to enhance the involvement of universities towards economic growth. As explained before, these reforms were instituted in response to a perception that Japanese universities were underperforming relative to their American counterparts, and that systemic reforms were needed to close the gap. (Walsh)
The Science and Technology Basic Law, 1995, set the stage for these reforms by committing to a major increase in public research funding, with a goal of encouraging technological development and economic growth, in part through university, industry and government cooperation. The Technology Transfer Law, 1998, allowed the establishment of Technology Licensing Offices (TLOs), independent of, but affiliated with, particular universities. In 1997, the restrictions on professors from starting businesses, or becoming directors or employees of private firms, were relaxed and after 1997, professors could work for companies while still engaged in teaching position with the aim of conducting or guiding ongoing R&D. Subsequently in 2000, the National Public Service Law was amended to allow professors and university researchers to take management positions in university startups and to join Scientific Advisory Boards of for-profit firms. In 1999 the Japanese Bayh–Dole Act was introduced and this made it easier for firms to obtain licenses to national inventions. Finally, in April 2004, the national universities became independent legal entities (Cao, 1994). The most significant change that this brought about was that incorporation gave the universities ownership of faculty inventions, which madel make the system of intellectual property (IP) ownership closer to that in the USA. The net effect was

that faculty at the newly-incorporated universities were no longer civil servants, freeing them from the burdensome government accounting system and strict civil servant's code of conduct.

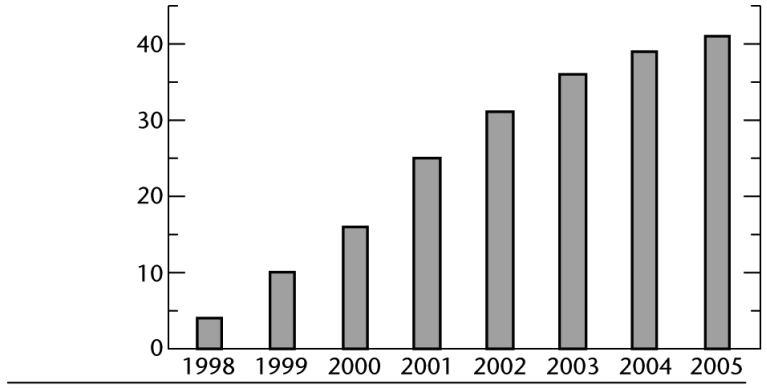

Figure 1. Number of TLOs, 1998–2005.
Source: FY 1998–2004 data from NISTEP, 'Analysis of achievement level of policies that specify numerical goals in the Science and Technology Basic Plans

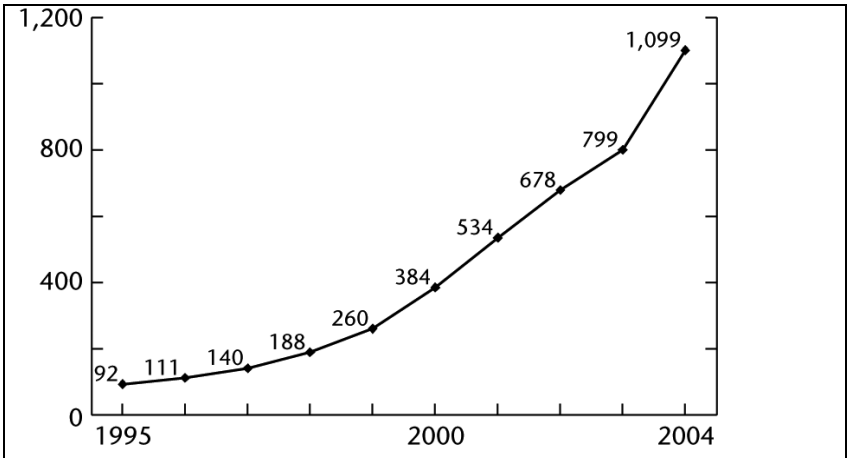

Figure 2. University-based startups, 1995–2004.
Source: D. Higashino, 'Changing environment for Japanese venture business', *Japan Economic Monthly*, May 2005, pp. 1–10.

The series of legislation had some profound effect in the university commercialization process which saw an increase in the number of TLOs, and startups see Figure 1 and 2, and also in a net effect increase in the number of patents that will be discussed in detail.

Funding in its crudest form enables the movement of technology from basic research in the labs to the market, the types of funding related to TT includes but not limited to Government or Federal Funding, Venture Capital funding Re-investment from profits in University-Owned spin-offs and licensing of university held patents and Philanthropy or Donations. From the plethora of literature we see that government or federal R&D funding provides a critical base for TT and commercialization efforts. In the United States, most universities successful in TT get a substantial amount of research funding from the federal government. Federal funding normally accounts for the majority of the universities' research expenditures. Apart from earmarked projects (Sanderson) Universities have to compete in a rigorous

process in order to be selected for funding. Latest figures by National Science foundation shows that Government spent about $19 billion n University research.

In spite of the low level of government funding to university research, Japan has embarked on reforms under the Science and Technology Basic Plan and has established venture business laboratories and regional joint research facilities in national universities to promote research aiming at creating new businesses and provides research funds for university-industry collaborative research.

1.2 Patenting and licensing

University patenting and licensing has its roots in the Bayh-Dole Act, as a consequence American universities now are interested in protecting their 'profitable' discoveries, just like any commercial firm engaged in R&D, and this has encouraged the creation of offices within the universities for the purpose of patenting (Etkowitz). Patents play the dual role as a supplementary source of funding and income for the universities in the form of licensing royalties and as a significant resource for many technological firms in industry through the licensing of the university-based technologies. In a recent survey by the Association of University Technology Managers (AUTM) the 194 members reported that overall 2003 technology licensing revenues exceeded $1.4 billion. This motivation is true for all the three nation, the difference lies in the number of patents filed per year, with the USA leading in the number of patents filed, the reason that many authors attribute to well defined legislations coupled with immense government funding.

Just like in the USA even though being late in adapting the Bayh-Dole Act, Japan has made considerable progress in shifting ownership of patents from industry to university. Previously industry and government benefited from "free ownership" of technology inventions derived from joint research with URIs and government. This was because prior to 2004 had no independent administrative or financial status, they were considered branches of the Ministry of Education, Culture, Sports, Science and Technology (MEXT) and therefore their labs were Japanese government labs. After Japanese universities were made into corporations in April 2004, and the adoption of the Bayh-Dole Act, many universities started owning inventions from faculty and even by some graduate students. Since it has not been long since the reforms took place, an accurate analysis of the impact cannot be made, nevertheless statistics from MEXT and the Ministry of Economic Trade and Industry indicate a significant increase in the number of patents filed from university.

1.3 Start ups and Spin-offs

Spin-offs which are companies formed based on research results can be an alternative to licensing out the technology to the child company in hope of getting returns for the parent company. Usually the parent company organizational structure is prohibitive for the new technology to be exploited hence an independent entity is set up so that the technology is efficiently commercialized.

By 2004 Japan recorded 1112 spin-off companies, a success largely attributed to government refocused funding on URIs to encourage basic research and a combination of the adoption of the Bayh-Dole Act and the restructuring of the law to allow Japanese universities to be run as a corporation, this together with the newly established Japanese TLO system that I will discuss later encouraged the formation of startups. There are four kinds of TLOs in Japan (Cao, PICMET2005) with one type formed as joint venture between universities and the private sector. This kind of TLO business goes beyond IP procurement and management, and facilitates technology entrepreneurship. For example the Kansai TLO has assisted university faculty members and researchers to start a technology startup and transfer technologies to these startup (Cao et al, 2005)

2.3 Incubators and Science Parks

Incubators and Technology zones programs designed to accelerate the successful development of entrepreneurial companies through a series of business support resources and services offered both in the incubator and technology park offices and also through their network of contacts. Whereas incubators focus on support of the start-up during the early-stage of the company's research and technology parks, on the other hand, tend to be large-scale projects that house everything from corporate, government or university labs to very small companies.

The Japanese research institutes go as far as developing incubators, however the government or research institutes have not aggressively engaged in the creation of science parks. This can be attributed to the fact that Japanese firms are usually large and established and in that sense conduct most of their

research in house. The Scenario is changing with most technological universities embracing the concept of developing an in house support system to nurture early businesses

1.4 Technology Transfer Offices (TTO) / Technology Licensing Offices (TLO)

TTOs and TLOs offer a mainstream but critical window for transferring technology. It is the first instance where invention is disclosed and its potential commercial value is assessed. The university TLO in the USA as typified by the Stanford University Office of Technology Licensing (OTL) has a staff of about 38 including the ones who do the licensing, in 2007 they had patent that cost over $3 million. The royalty derived from the license of a patent is split into 15% to the OTL; the rest is split into thirds between inventors, departments, schools after deductions of expenses. This approach is similar with the MIT TLO and Georgia Tech University TLO. However unlike other TLOs from Japan and China, the USA TLOs have a lot of interaction with the VC who are always on the "hunt" for new technology to invest in.

In Japan, the 1998 TLO law, "Promoting University-Industry TT", has ushered in a new relationship between inventors, universities and industry. In introducing this law, Japan initially followed, and then adapted, TLO strategies used in the USA, however it went a step further to initiate the intra-university IP Divisions, an exclusive member TLO system representing a couple of universities like the Tohoku Techno-arch (TTA) (Cao). These exist solely to give advice and support to those in universities who wish to bring their inventions to fruition and the Kansai TLO, which has seen some success in setting up start up companies and transferring technology to those specific startup companies.

2. Functional Portfolio: Kyushu university portfolio

The Kyushu university portfolio of industrial commercialization process has deviced a cross-institutional approach to formal and informal technology transfer system. Under the formal name of Intellectual property management center (IMAQ) was established to act as the core organization for promoting university-industry collaborations at Kyushu University. IMAQ's multi-faceted system ensures that the unique needs for university-business collaboration progress dynamically and in a sustained manner.
Established in October, 2003. IMAQ became the hub for the university's cooperation with businesses, and serves as an interface between the university, local communities, and industries. IMAQ is comprised of six Groups, which handle all aspects of cooperation between businesses, governments and the university

2.1 The Coordinate Group

The Coordinate Group offers a window for technological consultation and coordinates the work of university-business collaborations (e.g. technological consultation for a fee, joint or funded research, and, referral to other organizations) mainly for small- and medium-sized businesses in the kyushu area.

2.2 The Planning department

The Planning Department externally publicizes the study results, the technological seeds of Kyushu University, and university-industry-government collaboration activities at IMAQ and holds various kinds of workshops. Also, to have a collaborative activity with local communities , the Planning Department implements the joint research to solve various kinds of regional issues, and performs the collaborative operation with local communities by introducing the researchers and supporting the regional events and projects.

2.3 The Liaison Group

The Liaison Group focuses on responding to the needs of businesses and university professors, and works to optimally utilize the resources of businesses and the university. By coordinating and managing various projects, the Group increases the capabilities of companies and revitalizes study and education at the university. The work of the Liaison Group falls into four categories. Each task is coordinated and managed integrally throughout the entire process by special coordinators in the areas of: (1) marketing; (2) research and planning; (3) coordination; (4) contract administration; (5) project management, and (6) intellectual property management. We would like to be of assistance to your company.

2.4 TT Group

The TT group plays a major role in enlightening the community on intellectual properties this involve consultations on intellectual properties, organization of seminars on intellectual properties. They are also involved in developing strategies for protecting university owned intellectual properties and engaged in activities of processing for the disclosure of inventions. They also play a major role in marketing and licensing of intellectual properties, maintaining contracts and agreements and engaging in technological surveys

2.5 The Start-up Group

The Start-up Support Group supports efforts to start venture businesses that use the university as a stepping stone and utilize the university's vast resources including knowledge, technology, staff and related people (e.g. professors, students and graduates) and facilities. Previous focus has mainly been on venture businesses started by those involved with the university utilizing research results (seeds), however future plans are being set up to expand the effort to projects by people outside the university using the university's infrastructure.

2.6 The Project Support Group

The Project Support Group manages special projects (various ones dealing competitive research funds) for university-industry-government collaboration; also it manages consortium type joint research. The Group also aids in the Project Management Business Section. Specifically, the Group furnishes business guidance for various types of contracts between the organizations that participate in the project, project management, and intellectual property management. Moreover, the Group promotes a more stimulating approach to education at the university, research activities, and creating a university-industry-government model that will continue to prosper far into the future.

4. Conclusion

In the beginning of this paper we saw how the University-Industry relationships in United States, and Japan having evolved from different trajectories based on their unique historical contexts are now gravitating around a similar objective on the subject of leveraging TT for commercialization for economic growth and regional development through S&T. The United States university-industry TT continues to enjoy mixed success in university-industry relationship with its strong federal funding and a comprehensive VC industry.

The Japanese have made efforts to close the parallel between university and industry by adopting the American Bayh-Dole legislation which has given a new impetus to universities engaging in basic research by clearly defining ownership of inventions, coupled with the reorganization of public universities into semi-private agencies, universities in Japan have also contributed a lot towards effective TT and as such Japanese universities are coming under increasing pressure to engage in research activities more directly linked to economic and social return. The greater number of literature about TLOs in Japan (where four different kinds of TLOs exist) have led us to conclude that TLOs play a more comprehensive and diverse role in Japan than in the other regions as they fill the void that was drawn from parallel of the different objectives of academia and industry in Japan.

The Kyushu University sets a new trend in Japan by increasing entrepreneurial activities and a more direct engagement with the local economy which is bringing closer knowledge and practice. We have seen that IMAQ have a system that goes beyond a traditional university and adopted a weave of groups to and supporting infrastructure that have yielded to more start-up formations than the average university.

This paper leaves further research and sets start-ups as a new way of looking at the innovativeness especially of university based regional innovation system.

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