

CONTRIBUTION OF UNIVERSITIES TO REGIONAL INNOVATION VIA TECHNOLOGY TRANSFER

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Abstract

The Triple Helix model is a prescriptive model of innovation that takes a sociological perspective to explain how the reciprocal relations between university-industry-government contribute to the creation and capitalization of knowledge. The model emphasizes the role of the university as promoters of socioeconomic development especially in those regions with low technology dynamics. The conceptual framework developed by Gunasekara which combines the triple helix model and the engaged university theory, is applied to perform a comparative analysis of the current role of two Mexican universities –one private the other public- in terms of their contribution to regional development. Results shows despite the efforts of both universities to establish links with the public and private sectors, they only play a developmental role. Important changes in technology, research and innovation policies are required to support the establishment of the multiple reciprocal relations claimed by the Triple Helix model. Regional universities need to do more than promote entrepreneurship, create incubators and support joint research projects with local enterprises to play the generative role universities have under the triple helix model.

INTRODUCTION

The Triple Helix Model proposed by Etzkowitz (2006) and further developed by Leysdesdorff (Leysdesdorff and Etzkowitz, 1996) takes a sociological perspective as it describes the multiple reciprocal relationships among the public, industrial and academic sector at different stages in the creation and capitalization of knowledge and innovation (González de la Fe, 2009). Under this model, “the future location of research and technology transfer reside in a ‘triple helix’ of university-industry-government relations that play off a set of technological sub-dynamics” (Etzkowitz and Leydesdorff, 1999). The evolutionary interpretation of the Triple Helix model stresses the role of universities as promoters or generators of socio-economic development in particular for those regions with poor R&D investments and technology base. The model focuses in the role of the university as the promoter of spiral trilateral interactions that result in the formation of hybrid university-industry-government projects like industrial parks or technology incubators with the potential to build up resources and increase the formation of intellectual capital (Etzkowitz, 2002). Then under the Triple Helix model, universities are not only responsible of education and research, but also play an active role in the socioeconomic development of their region of influence by providing knowledge-based innovations.

Four elements are recognized by Gunasekara (2006) as critical to achieve socioeconomic development: (1) regional agglomeration, (2) proximate stock of human capital, (3) an associative governance framework and (4) a trust a cooperation culture. This author claims that these factors could be useful to explain the various roles of universities at different regional settings. In the case of Mexico many universities are located in regions with well identified clusters of firms and human resource availability, being the other two factors more determinant to understand the differential degrees of contribution of regional universities to socioeconomic development. Gunasekara (2006) combines the triple helix model and the engaged university theory -which emphasizes the adaptive responses to universities to engage with private and public actors- to develop a conceptual framework that could explain the variations in the roles of universities in the development of regional innovation systems. The objective of this work is to use that framework to analyze the role a particular Mexican university is performing to contribute to regional development and in particular to determine if the university is assuming a generative role in agreement with the triple helix model.

CASE DESCRIPTION

The unit of analysis is a middle-size private university located in a major city in the state of Mexico, this state is one of the most important located in the central part of Mexico as it contributes to 9.7% of the national gross product only after the Federal District (21.5% of NGP). According to the Ministry of Economic Development of the state (SEDECO: <http://www.edomexico.gob.mx/sedeco/>) 285 industries operate in the 14 industrial parks of the state, 5 of these parks are located in the metropolitan area of the city where the university is located. The region is dominated by manufacturing, 219 (77%) of the registered industries are manufacturers, being the main sectors the automotive and textile. Within the metropolitan area of the city there are several private universities, two of them with similar size than the one under analysis, but these universities are centred on education, research and innovation are not in their mission. There are also two public universities, one of them is a major public institution and the other is oriented to Engineering and Technology programs. These institutions are focused more on satisfying the superior education needs of the region -not necessarily those of the productive sector but of the superior education aspirants- and their engagement with the community is mainly through the social service of the alumni.

The private university was created thanks to the initiative of a local industrial group with some support from the government which donated the terrain where facilities are located. This university offers five careers in Business, two in Social Sciences and seven in Engineering. At the graduate level there are three master programs in Business (MBA, executive MBA and Development of SMEs), three in Engineering (Mechanics, Industrial and Electronics) and a PhD program in Engineering. The university has a limited research role -the regional public university dominates this role- the Research Centre in Strategic Studies have been mainly dedicated to offer training, and only until recently it has been involved in the program of integration of competitive industrial clusters sponsored by the state government. During 2004 senior management supported the creation of another two research centres, Industrial Engineering and Mechanical Engineering, the objective of the centres was to provide specialized technical and consulting services to the industries of the area. In addition, the rector of the university offered grants to support the formation of research groups with the idea of integrate education and research in order to support the formation of links with the industry via joint projects. The business incubator was formally created in 2001 and in 2004 was certified by the Ministry of Economy as relevant to regional needs. The incubator services include technical advice for the development of the new venture, connections with other entrepreneurs and potential suppliers or customers, negotiation to apply for funds offered by government and a physical and virtual space for the future business.

METHODOLOGY

Multiple interviews with key informants were completed to obtain the data for the case analysis; in addition several documents were revised among them the Web pages of the institution containing information about relations with industry or government, research activities and contents of education programs; the stated university mission, and the convocations of local governmental institutions for research projects. The interviewees include the academic researchers, the chairman of the Research and Graduate Studies, the director of the business incubator and the directors of the three established research centres (Industrial Engineering, Mechanical Engineering and Strategic Studies). In order to contribute to the regional economic development, the university has implemented two main strategies within its education programs. One is the promotion of an entrepreneurship culture among students; all students are required to complete a 60 hours Entrepreneurship course and elaborate a business plan for a new venture which is evaluated by a group of academics and industrial professionals. The other action was the introduction of a Strategic Technology Management course (mainly oriented to Information Technology) into the curricula of the MBA program. The objective of this course is to develop technology management competences among participants, these participants occupy middle and top management positions in the local industries and many of them are responsible of the introduction, evaluation and transfer of technologies within their firms. With respect to the initiative for technology transfer, this work recorded the experience of 42 executives enrolled in

the MBA program. After participants accomplished the strategic management course, they were asked to perform a diagnosis of the technology situation of two firms. After the diagnosis, they were asked to select one of the firms and required to elaborate a technology plan for the chosen firm.

DISCUSSION OF RESULTS

First part of the analysis was to determine the role of the university in socioeconomic and innovation development in terms of its contribution to the advance of the four key regional factors characterizing an innovation system.

1. Regional agglomeration or clustering

The entrepreneurship courses are identified as the main activity focused on the creation of new firms. However these courses are oriented to the formation of entrepreneurial capabilities; the projects developed during the courses have only an academic purpose and only occasionally result in a new venture. The creation of a new business occurs only when the individual (the student) asks for the incubator services or directly requests additional assistance from faculty to concrete the idea. In addition, most of the projects are in the service sector in contradiction with the declared university's orientation to support industrial activity via technology innovation and transfer. With respect to the business incubator, it also hosts new ventures in the service sector, none involving entrepreneurial professors or technologies developed by the university. Except by two projects which require the introduction of new technologies in materials and equipment, all others are related to the commercialization of standard products which do not even call for the adoption of process technologies. The incubator has benefited from the injection of capital from the State government and the Ministry of Economy, but there is no evidence that this funding and the certification to the incubator model have resulted in the creation of an important number of new firms. No more than five firms per year have "graduated" since its creation; however it has been in full operation only since 2004 so there is opportunity for a real contribution.

Research in developing regions (Doner and Hershberg, 1999) indicates that local manufacturing processes, products upgrading and intellectual capital formation can occur incrementally when learning occurs in regional industrial clusters, while governmental policies provide the governance structure required to facilitate coordination. The intervention of third parties able to offer knowledge intensive services (KIBs) has been identified by Smedlund y Toivonen (2005) relevant to the formation of intellectual capital and the sustainability of productive networks. However, the limited research capabilities of the university have restricted their contribution to the formation of intellectual capital within the regional clusters. Its role is a provider of specialized training and a facilitator of the interactions between the regional industrial clusters and the state authorities instead of a knowledge transfer agent. The Centre of Strategic Studies supports regional clustering via three activities: a) performance of diagnosis studies intended to determine the strengths, weakness and requirements or current industrial agglomerations in the area, b) development and instruction of generic training courses to improve the business capabilities of the CEO/owners of the business that integrate the cluster and 3) negotiation and advice with respect to conflict resolution. The other two research centers have played an even more passive role, mostly limited to the offer of specialized services when required by the industries that want to become suppliers of lead automotive firms.

2. Human Capital formation

The university main focus is on student recruitment and retention encouraging students to develop projects required by local firms (e.g. marketing research, warehouse layout, quality control, etc.) as part of their courses' requirements. In addition, students need to accomplish 240 of professional service. These actions contribute to the development of links with the local enterprises, but these ties are temporal and involve individual transactions meanwhile the human capital dimension included in the triple helix implies complete cross-institutional mobility and to conceptualize the "student" as a "potential innovator" not the responsible of a basic project. One of the two most recent BS programs (Creation and development of enterprises) is intended to contribute to auto-employment and the formation of new firms that could reactivate the regional economy. Since the program was opened this year (2010) no prevision about venture capital has been made. With respect to faculty, the university's authorities have tried to accelerate the creation of "knowledge spaces"

(Etzkowitz, 2002) by asking research groups to include international partners from developed regions as a way to raise the research level and to take advantage of international R&D funds. To make these knowledge spaces potential sources of regional development, the research projects are required to contribute to the competitiveness of the local industry, in particular the automotive. However so far these actions have not resulted in the formation of inter-organizational and/or multidisciplinary groups (Engineering and Business are clearly separated schools) or in a re-position of the university's role as the driver of regional innovation or a centre of knowledge capitalization.

Traditionally, the master programs hosted by the Business School are mainly oriented to meet the professional competences required by the organizations where participants work. The development of technology competences has been considered by the university as a novel alternative to contribute to the technology dynamic of the region and the competitiveness of the industrial base, this last point presupposes that the application of technology to perform multiple business process (not only production) is relevant to accomplish the business strategy. The information collected from 33 executives enrolled in the MBA program showed technology competences were considered of lower priority to perform current managerial tasks or be promoted. Generic competences (e.g. ability to solve problems and working in teams) and interpersonal and communication competences (e.g. networking and negotiation) were judged more relevant than competences related to technology decisions such as the elaboration of a technology plan or identification/selection of technology suppliers. The analysis of the qualitative tasks performed by another group of 42 executives showed they undervalued the role of technology as enabler of the business strategy. The Strategic Technology Plan elaborated by the executives revealed high competences in Technology Alignment and Technology Portfolio Management but a deficient development of competences related to the management of technology change. The Triple Helix perspective assumes the innovations resulting from the collaborative actions of government-academia-industry will be capitalized when transferred and implemented by the productive sector, but the decisions to introduce such technology innovations are in the hands of executives who undervalue technology competences and the abilities of the local universities to provide the required technology. This calls for a change in culture and a reposition of the university as a qualified research and technology centre.

3. Associative Governance

The university has sustained linkages with the industry since its creation, but these linkages have not resulted in transfer of innovations as the university has taken a traditional position and supported the development of projects that attend specific industrial needs. When decided to encourage research, university's senior management established research lines in agreement with the characteristics of the industrial base, then projects focused on the competitiveness of the automotive industry were number one to receive financial assistance. In addition, university senior authorities offered special assistance to professors who had technology developments so they can patent and transfer their innovations. In order to support the regional industry, during the last three years the state government has offered grants to support cross-institutional (industry-university) research projects. One of the sectors receiving support is the automotive due to its economic contribution to the state's economy; small business can also apply for government funds because they constitute the main economic base of the region and make a substantial contribution to employment. As a result, the automotive manufacturers (tier one suppliers in particular) have approached the Mechanical Research Center to look for research partners and take advantage of the government funds while some scholarship have been granted to the participants of the Master in Entrepreneurial Management oriented to the escalation of established family business. The strategy of regional development is the hands of state and local government, the university has only provide some support to perform diagnosis studies to identify the main problems faced by regional clusters or specific sectors. However, the university authorities strongly support the cooperation with industry but no specific guidelines or rules have been established to facilitate such interaction.

4. Regional Cultural Norms

The prevalent culture makes a clear separation between the education and productive sectors. In general industries and small firms do not believe universities are able to provide realistic solutions to their problems then they are reluctant to establish relations with universities. Many manufacturing

firms in the region are subsidiaries of large multinationals then they rely on their headquarters for technology transfer and do not tend to establish knowledge linkages with local universities. In addition, the small firms mainly operate in the service sector therefore they do not demand specialized knowledge and have limited capital to pay for technical consulting or training. Private funding for research is not part of Mexican culture; it is the government sector which supplements the resources and incentives to research mainly through the public universities.

Table 1.
Factors explaining the developmental role in the regional development of the unit of analysis

Explanatory Factor	Local private university (Unit of Analysis) situation
1. University Orientation Engagement	1.1 Long tradition of commitment with industry and in a lesser degree with government 1.2 Associations created/administered at the individual level 1.3 An entrepreneurial culture and recent efforts to increase contribution to regional development via creation of new ventures and technology transfer
2. History of University-Region linkages	2.1 Historical relations industry-university. 2.2 Limited research projects, most linkages have been focused in human resource training. 2.3 Occasional projects with government, promoted by individuals. 2.4 Limited compromise with community other than through education programs.
3. Complementarity of Fields	3.1 Not a research institution. Absence of a significant number of technology projects. 3.2 In the last 3 years efforts to support research and promote technology innovation in strategic areas identified by government. 3.3 Research lines in alignment with main regional industrial activity (automotive, SMEs business base) and general knowledge needs (energy, sustainability) 3.4 Weaker alignment with knowledge demands of small firms and service sector
4. Champions	4.1 Academics 4.2 Recent creation of research centres which are far away of developing solid linkages with industries or governmental agencies 4.3 University senior managers promote relations with industry and government via informal and formal projects but no real influence in shaping a regulatory framework for industry-government-university interactions.
5. Nature of Industry Base	5.1 Manufacturing with a strong automotive base 5.2 Largely micro and small firms but also medium to large organizations which make a strong contribution to employment and economy.
6. Regional Culture	6.3 Poor understating of the contribution of innovation to regional development 6.4 Universities lack credibility as options to solve practical business problems or technology suppliers 6.5 Government, productive an education organizations have traditionally work in isolation, they do not perceive advantages of cooperation until recently thanks to new governmental policies
7. Political and Economic conditions	6.1 Some political support for the development of the region in particular by promoting industrial clustering in "strategic" sectors and incubating new business. 7.2 Economic situation could favour the exploration of cooperation alternatives to accumulate and improve use of resources and capitalize knowledge. 7.3 Economic situation restricts the private investment in R&D and the availability of R&D government funds; university funding is based on enrolment while industry is struggled by survival.

CONCLUSION

The conclusion derived from the analysis (Table 1.) is that the unit of analysis performs a developmental role in three of the key elements of a regional system – regional clustering, human capital formation and associative governance- and a non-significant role in the fourth, regional cultural norms. The entrepreneurial culture promoted in the university has the potential to make a contribution to regional clustering and human capital formation provided the university is able to consolidate research lines in alignment with the technology and knowledge needs of the region. With respect to contribution to associative governance and regional cultural norms, government intervention is required as local industries are not used to finance regional R&D or cooperate with universities. Then the interactions claimed by the Triple Helix model are far away to be observed in a medium-term horizon. The economic recession has a significant and adverse effect on the advancement to such model: university has limited resources to strength research; governmental funds to support R&D collaborative projects have reduced and industries are facing multiple economic problems that restrict technology innovation.

This work applies the framework proposed by Gunasekara (2006), based on the triple helix model and the university engagement, to analyze the case of a regional university located in the metropolitan area of a major city in the state of Mexico. The analysis of the case showed the university plays a developmental role in three of the four critical elements of a socioeconomic system: cluster agglomeration, human capital formation and associative governance, and a non-significant role in the fourth, regional cultural norms. This regional Mexican university is basically taking a reactive position and adapting their educational programs and research efforts to satisfy the industry and business environment demands. The business incubator and the university research centers have not yet made a substantial contribution to the formation of new ventures and the capitalization of knowledge. The promotion of an entrepreneurial culture has resulted in new services business that are created with the assistance of public or personal funds while the program to develop technology competences has not contributed to the appreciation of technology transfer and innovation among business graduate students.

REFERENCES

- DONER, R. F. y Hershberg, E. (1999). "Flexible Production and Political Decentralization in the Developing World: Elective Affinities in the Pursuit of Competitiveness?" *Studies in Comparative International Development*, Vol. 34 (1) :45-82
- ETZKOWITZ, H. (2006). *The Triple Helix: university-industry government, innovation in action*. New York: Routledge
- ETZKOWITZ, H. (2002). "The triple helix of university-industry-government, implications for policy and evaluation." Working paper 2002-11. Institutet för studier av utbildning och forskning. Stockholm. Available on line, last time accessed 02/03/10 http://www.sister.nu/pdf/wp_11.pdf.
- GONZÁLEZ de la Fe, T. (2009). "El modelo de triple hélice de relaciones universidad, industria y gobierno: un análisis crítico." *ARBOR Ciencia, Pensamiento y Cultura*, CLXXXV 738 (julio-agosto), pp. 739-755. Available on line, last time accessed 02/03/10 <http://arbor.revistas.csic.es/index.php/arbor/article/view/327/328>.
- ETZKOWITZ, H., Leydesdorf, L. (1999). "The future location of research and technology transfer." *Journal of Technology Transfer*, Vol. 24 :11-123
- GUNASEKARA, C. (2006). "Reframing the role of universities in the development of regional innovation systems." *Journal of Technology Transfer*, Vol. 31 :101-113
- LEYSDESDORFF, L., Etkowitz, H. (1996). "Emergence of a triple helix of university-industry-government relations." *Science and Public Policy*, Vol. 23 (5) :279-286
- SMEDLUND, A., Toivonen, M. (2007). "The role of KIBS in the IC development of regional clusters." *Journal of Intellectual Capital*, Vol. 8, no. 1, :159-170