

# HIGHER EDUCATION INSTITUTIONS IN THE REGIONAL INNOVATION SYSTEM IN BAJA CALIFORNIA

Alejandro Mungaray\*

Jorge Ramos\*\*

Ismael Plascencia\*\*\*

y Patricia Moctezuma\*\*\*\*

Translator: Pablo Contreras Fresán

E-mail: [deepcolearning@gmail.com](mailto:deepcolearning@gmail.com)

\* PhD in Economics from UNAM; Secretary of Economic Development, State of Baja California; Professor, Faculty of Economics and International Affairs, UABC. Researcher SNI Level II.

Email: [amungaray@baja.gob.mx](mailto:amungaray@baja.gob.mx)

\*\* PhD in Business from UABC; Technical Secretary of the State Council for Science and Technology; Professor, School of Accounting and Management, UABC Tijuana.

Email: [jorgeramos46@hotmail.com](mailto:jorgeramos46@hotmail.com)

\*\*\* Ph.D. in Economics from UABC. COCYT Research Coordinator; Professor, School of Accounting and Management, UABC Tijuana. Researcher SNI Level I.

Email: [ismael\\_plascencia@yahoo.com](mailto:ismael_plascencia@yahoo.com)

\*\*\*\* PhD in Public Service from UNAM; Director, Faculty of Economics and International Affairs, UABC. Researcher SNI Level I.

Email: [moctezuma@uabc.edu.mx](mailto:moctezuma@uabc.edu.mx)

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## Resumen

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La aspiración de una sociedad es lograr niveles superiores de bienestar en términos de salud, educación e ingreso. Si bien el crecimiento no garantiza una distribución adecuada de los ingresos, servicios educativos y de salud, dicho crecimiento es una condición necesaria para tratar de resolver los problemas de desigualdad con políticas públicas. Regiones con mayor crecimiento son aquellas capaces de innovar en sus instituciones. Las instituciones de educación superior deben desempeñar un papel central en este proceso. Baja California trabaja en la conformación de un sistema regional de innovación que sirva de base para el fomento de oportunidades y el desarrollo de industrias basadas en el conocimiento.

Palabras clave:

- Baja California
- Sistema Regional de Innovación
- Instituciones de educación superior

## Abstract

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The aspiration of a society is to achieve higher levels of welfare in terms of health, education and income. While growth does not ensure adequate distribution of income, education and health services, this growth is a necessary condition to address issues of inequality through public policy. The fastest growing regions are those able to be innovative in their institutions. Higher education institutions must play a central role in this process. Baja California is working on the establishment of a Regional Innovation System as a basis for the promotion of opportunities and development of knowledge-based industries.

Key words:

- Baja California
- Regional Innovation System
- Higher education institutions

## Introduction

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This article explores the characteristics that higher education institutions (HEIs), Universities and research centers in Baja California, should develop in the context of a regional innovation system in the making. The evolution of regional innovation systems in other parts of the world place knowledge at the heart of sustainable economic development. The engagement between HEIs and the business community is based on a greater interaction around the usefulness of knowledge. Undoubtedly Baja California's HEIs are moving toward closer links with companies involved regionally in research and development activities that promote higher levels of competitiveness. Finally, several recommendations are presented for public policies focused on the HEIs in the context of the creation of regional innovation systems based on an analysis of best practices at the international level.

The importance of higher education institutions as a hub for the development of a regional innovation system (RIS) has been well documented. In the u.s. the two most successful clusters of high technology companies in information, communication and biotechnology, are located in Boston and the Bay Area of San Francisco, where the four best universities in the country are also located. The presence of world class universities in these regions is at least partly responsible for regional success. Their students and graduates often remain in the area, some become entrepreneurs and the results of research carried out by scientists become a source for new businesses (Chen and Kenney, 2007).

The three pillars of a successful RIS are the companies (organized in functional clusters), the academic sector (through an educational offer that is timely, relevant and with effective mechanisms for technology transfer) and government (through a proactive policy with targeted and strategic actions). The discussion about a RIS has been based on developed countries, but it begins to take hold in emerging countries. In the context of the current crisis, strengthening scientific technological and innovation capabilities is increasingly presented as a good strategy for regional development as well as rethinking the goals of long-term competitiveness, duly articulated with short and medium term goals allowing the restructuring of entrepreneurial activity in this direction.

## HEIS in regional innovation systems

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Universities have been regarded as essential institutions for the development of national innovation systems (Lundvall, 1992, Nelson, 1993). Although for some time the analysis was maintained at the national level, geographers argued that innovation systems have a strong regional imperative (Cooke, 1992, 2001, Storper, 1997). The literature broadly defines a regional innovation system (RIS) as a network of institutions, policies and stakeholders that sustain and support scientific and technological progress. In economies increasingly based on knowledge, higher education institutions (universities and research centers) are vital players in the creation, acquisition, dissemination and utilization of knowledge (Nelson and Rosenberg, 1993), contributing to the development of regional innovation systems with businesses and government. Consequently, innovation is conceived as the ability to detect, create, disseminate and adopt new ideas to transform them into profitable products, processes and services, leading to productivity growth, competitiveness and economic welfare. Innovation was initially conceived as a linear process going from basic research to technology transfer and supplemented by marketing. Since the nineties, numerous contributions began to question this rationality through systemic and complex models for innovation, emphasizing a deliberate effort, through interactions, HEIS and government, to develop a sustainable and dynamic regional innovation environment.

HEIS combine the functions of educating and research. This joint function of training staff and advanced research is often more effective than specializing in one activity or the other. For example, mobilizing qualified human resources to the industry or any other occupation, is a powerful mechanism for the dissemination of scientific research as well as to address the demands of students and their employers in curricula, reinforce links between the academic research agenda and societal needs (Mowery and Bhawe, 2005).

Higher education institutions “products” of economic importance come in many forms and vary over time, between regions and according to the industrial context. These include, inter alia, scientific and technological information, which tends to increase the efficiency of research and applications that have a real and measurable impact; instruments and equipment used by companies in their production processes and research activities; skills and human capital comprised in the students and staff members of schools, faculties or departments, networks of scientific and technological capabilities that facilitate the dissemination of knowledge and the development of prototypes for new products and processes.

**Table 1**  
**HEIS products for RIS**

| Products                                   | Impact on the RIS   |
|--|---|
| Human capital and skills                   | Improve systemic performance through the capacity and interactions between HEIS and business staff.                             |
| Scientific and technological information   | Increase in efficiency for the development of technological applications through R&D.   |
| Infrastructure, facilities and equipment   | Joint use of facilities (industry and HEIS) for production processes and/or research, fostering involvement and cost reduction. |
| Science and technology capability networks | Facilitate the spreading of knowledge among system stakeholders.  |

Source: Author's based on Mowery y Bhaven (2005).

According to Gibbons (1997), most universities are rigidly organized, based on disciplinary science structures, therefore they are being impacted by social forces such as globalization and competitiveness. The fundamental change is the emergence of a distributed production system in which knowledge generation is no longer the preserve of the HEIS. Accordingly, we begin to recognize that the production and dissemination of knowledge are not self-contained activities or a quasi-monopoly which are carried out in HEIS. As such the real challenge will be the timely generation of knowledge workers and entrepreneurs required by development and the pragmatic use of research generated by other producers of knowledge.

This situation arises because knowledge is not produced where it is needed and, therefore, universities will have to cleave to new intellectual resources from outside their boundaries, so they can interact with some effectiveness in a distributed knowledge production. For this, HEIS should develop more and better links with the society around them. The model is an ad hoc referral to place these players in a RIS for Baja California, where everyone works in coordination with other agents even to the point of becoming strategic axes in the generation and distribution of knowledge. This means moving from one mode of production, of knowledge as an end in itself, to another one that considers the solution of complex problems in a competitive global context.

**Table 2**  
**Gibbons, 1997 models of knowledge production**

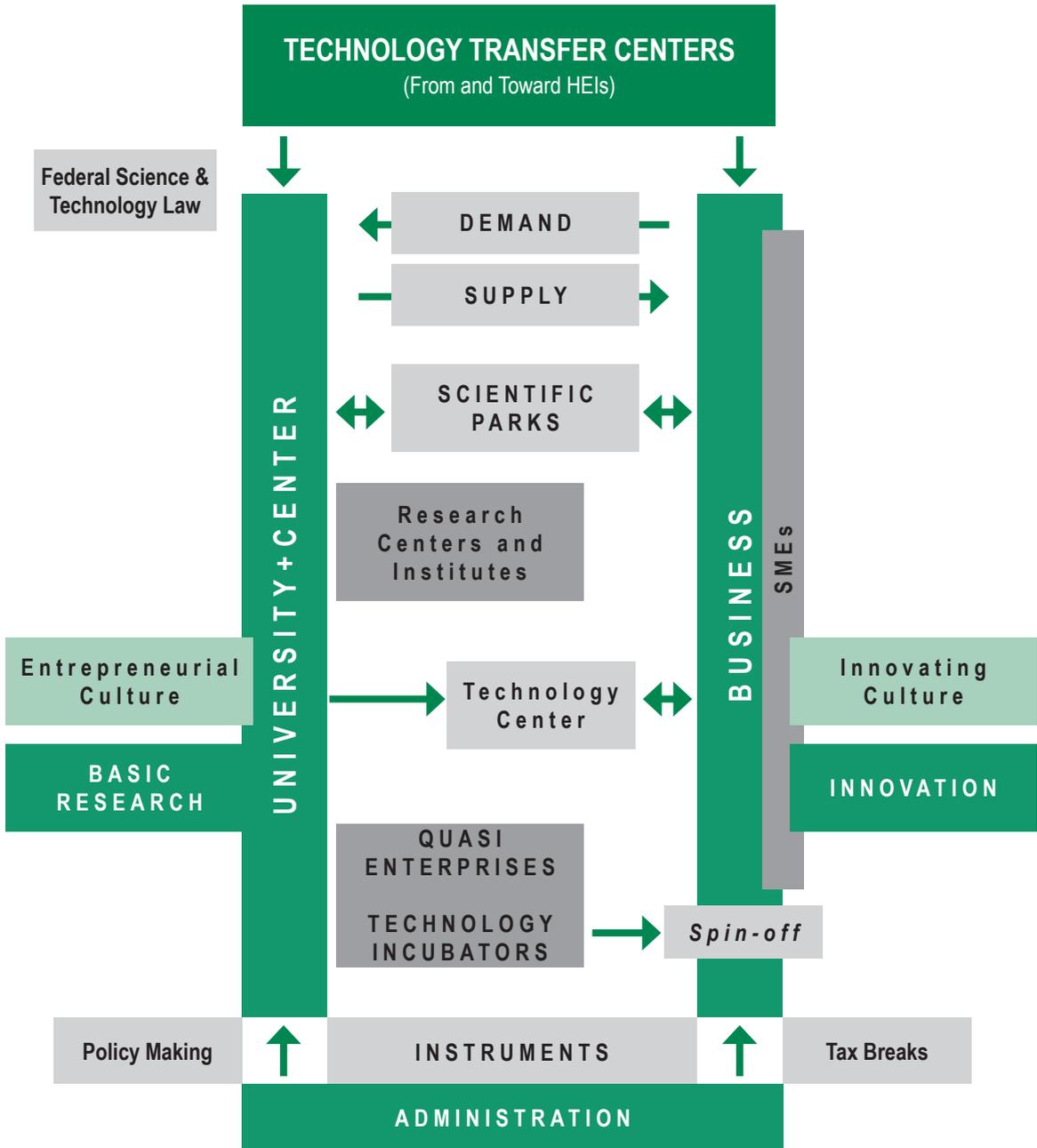
| Characteristics      | Mode I               | Mode II           |
|----------------------|----------------------|-------------------|
| Knowledge production | Based on Disciplines | Multidisciplinary |
| Location             | Academia             | By application    |
| Practitioners        | Specialists          | Extended group    |
| Groups               | Continuous           | Transitory        |
| Organization         | Hierarchical         | Mixed control     |
| Structure            | Uniform              | Diverse           |
| Feedback             | To stakeholders      | Reflexive         |
| Accountability       | To government        | To society        |
| Quality control      | Arbitrated           | Broad base        |

Fuente: Gibbons, 1997.

To achieve this, HEIs need to expand their functions of exchange/transfer of technology through alliances and partnerships established as formal policy as well as the establishment of missions that reflect a true organizational commitment and resource allocation. The HEIs institutional policy should allow, increasingly, the participation of their faculty in activities associated with the research, development and commercialization of public and private projects. This is achieved without seriously altering or damaging the university institutional atmosphere, when it is acknowledged that teaching and its improvement is a central component of research (Gibbons, 1998). To the extent that HEIs recognize their obligation to serve society through knowledge transfer activities, the university's purpose and the individual interests of companies will converge. These facts were recognized in the decree to amend the Federal Law on Science and Technology, which includes incentives for innovation and development. The change from the HEI as we know it to the entrepreneurial and interactive HEI requires defining the university's mission and vision in the knowledge economy era, as well as the current study of the technology transfer dynamic model arising from the "Triple Helix" concept of the University-Industry-Government relationship (Etzkowitz, 2003).

Figure 1

Schematic representation of science, technology and innovation, University-Business



Source: Rubiralta, 2003.

## Public policy for HEIS in the regional innovation system

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HEIS conducting research play an important role as a source of information and essential knowledge. Occasionally they are a source of relevant industrial technology to support a knowledge-based economy. In recognition of this fact, national and regional governments have launched numerous initiatives since the seventies to more effectively link universities with entrepreneurial innovation processes. To this end “science and technology parks”, support for “business incubators”, public funds, “seed capital” and the creation of other forms of “bridging institutions” to link HEIS with business innovation, have been created and developed.

Governments seek to increase the transfer rate of advances in academic research to industry to facilitate its implementation by domestic firms in a broader effort to improve national economic performance. According to the OECD (2008), national policies must now adapt to different “types” of regions, based on the characteristics of their business profile, industrial and scientific capabilities. There are also the public policy trends of advanced countries and regions that become best practices for developing countries with appropriate adjustments to advance in the creation of a RIS. Adequate strategies should emphasize the regional level, because only in this area national strategies for research, development and innovation are possible (Munger and Palacio, 2000). The development of regions based on their assets and the agreement of local stakeholders to establish goals for the short, medium and long term to generate systemic competitiveness is the best strategy (Howells, 1999). In the case of Mexico the strategy has been to subsidize lagging regions, redistributing from advanced regions or states.

The OECD (2009) regional policy approach suggests to serve and include lagging regions incorporating micro, small and medium enterprises, sectorial aspects related to innovation, and to place a greater emphasis on the commitment of both public and private stakeholders. Therefore, regional policy is based on a policy of scientific and technological innovation that permeates across society. This requires concrete interaction, cooperation, teamwork and a multidisciplinary approach to connect isolated efforts.

While there is a relationship between HEIS and large companies, a new goal should be linking HEIS with micro, small and medium enterprises. HEIS are required to be key partners in the regional innovation programs, governed by a policy of engagement with business development policy, for research without marketing does not result in innovation.

Public policy programs for business development need to act as “drivers” of regional growth, support industries and sectors in transition to convert jobs, help small and medium companies in the assimilation of technologies for growth, and further the competitive advantage by promoting exports and the development of regional trade brands to attract investment.

**Table 3**  
**Public policies for the creation of a regional innovation system**

| Policy                        | New Approach   | Old Approach  |
|-------------------------------|--|---|
| <b>Regional</b>               | Development of competitive regions bringing together local assets and actors.                  | Redistribution from advanced to lagging regions.                  |
| <b>Science and Technology</b> | Joint financing of research involving networks of HEIS with industries and links to marketing. | Financing of sectorial and individual projects on basic research. |
| <b>Higher Education</b>       | Promoting engagement with business and joint research for technological development.           | Focused on teaching and basic research.                           |
| <b>Business Sector</b>        | Support common needs for business groups involved in the assimilation of technologies.         | Subsidies (tax cuts) to national leading corporations.            |

Source: OCDE, 2009

Vincent-Lancrin (2006) argues that regional opportunities are designed around two dimensions: “directed management” versus “market forces” and “international approach” versus “regional approach”, the horizontal axis emphasizes the pattern of governance of higher education as a whole: is it governed by supply driven administrative rules, or is it driven by market demands? The vertical axis emphasizes the depth of international integration in higher education, without losing sight of regional performance through collaboration and competitiveness. The scenarios in Figure 2 show that globalization and the specific modes of delivery (public or private) are conceptually disconnected. Internationalization does not necessarily involve trade liberalization (scenario 1) although it can (scenario 2). Conversely, market mechanisms are not necessarily related to private educational institutions or internationalization, but can be used in a framework for public administration (stage 4) where the HEIS respond to market incentives.

Figure 2

The four scenarios for HEIS research and development



Source: Authors' based on Vincent-Lancrin (2006).

These scenarios are complex and multidimensional and are not mutually exclusive. An interesting point is that the scenarios are different enough so as to generate a public discussion in Baja California, which as a region is already economically integrated with Southern California, yet needs stronger efforts to integrate HEIS activities.

## The Baja California research, innovation and technological development system

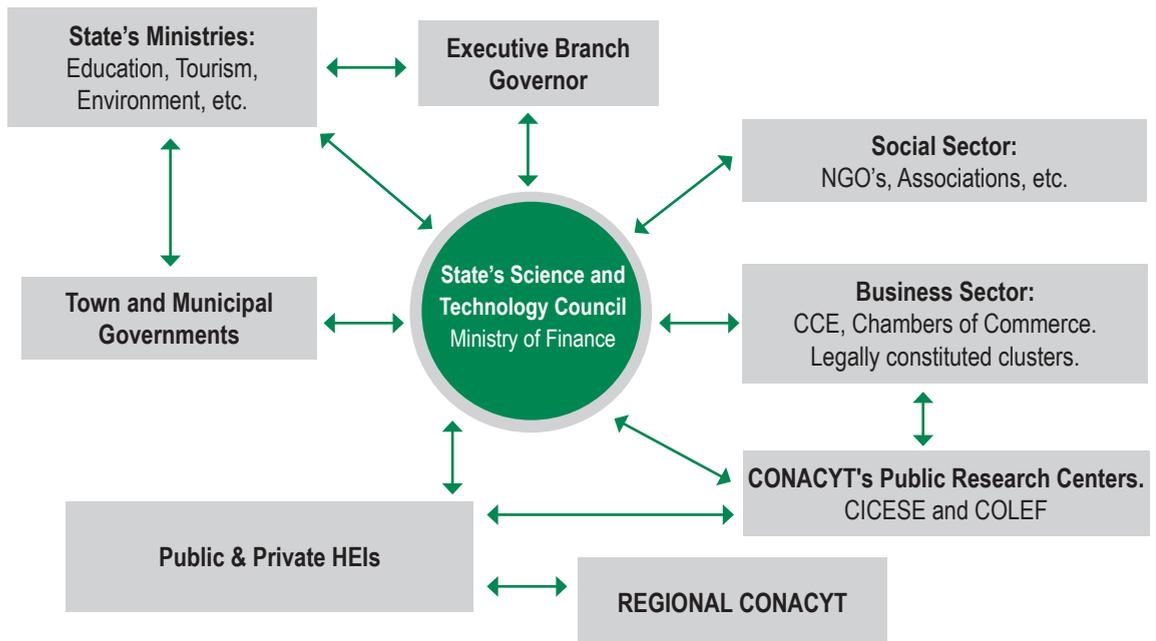
Currently there is a National Council of Science and Technology (CONACYT) decentralization policy, where regions with higher capabilities will be in a better position to absorb rights and responsibilities in matters of science and technology. One of the programs through which CONACYT is devoting more resources to R&D in the states, is through the Mixed Fund. Despite Baja California's relative importance in terms of its contribution to national economic activity, it had not been able to increase its participation in the Mixed Fund, using this as a benchmark for all CONACYT programs.

To increase the State's relative participation in funding it is necessary to improve its skills, thus HEIS are the natural entity for improving regional coordination. According to the OECD (2009), few business policies have been developed in various states of the country taking into account regional particularities. In Baja California there is an effort to meet the goals and objectives of the State's Development Plan through fostering science, technology and innovation. With the integration of the State Council for Science and Technology to the structure of the Ministry of Economic Development and the drafting of Baja California's Special Program for Science and Technological Innovation 2009-2013 (PECIT), a means has been created for transitioning into a better governance system in order to achieve greater linkages between the various academic and research, business and government sectors. In its scope it incorporates concepts that are relevant to regional competitiveness and the economic and social development of its population.

In Mexico a RIS has been considered the inventory of the states or territories scientific and technological capabilities (OECD, 2009, Scientific and Technological Consultive Forum, 2009). Nevertheless, it is proposed that the substance of a RIS is not the agents performance when taken in isolation or its abilities in terms of infrastructure, but rather as functional parts of an integrated nonlinear system. System and Innovation Research and Technological Development of Baja California (SIIDEBAJA) is a deliberate effort for the creation of a Baja California RIS. Initially it consists of nine public and private HEIS in the state. There is linkage between universities and businesses through the Professional Social Service, placement programs and internships for students to participate in research projects with members of the HEIS. However, SIIDEBAJA can scale the linkage for HEIS scientific research to be tied to the technological development of industry (SIIDEBAJA, 2009).

Figure 3

## SIIDEBAJA'S Stakeholders

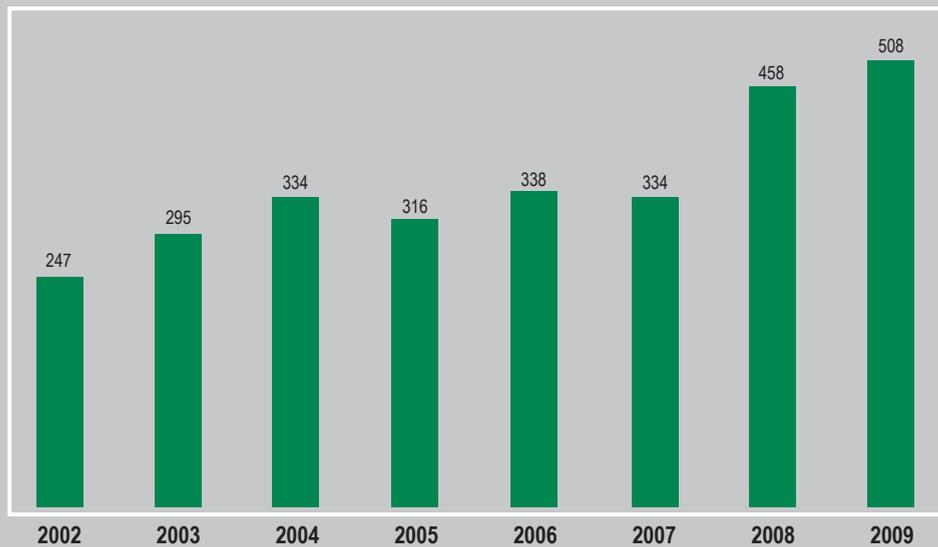


Source: Authors'

With the creation of SIIDEBAJA, a government commitment to knowledge generation and innovative applications is established, resulting in the fundamental pillars of a high quality and relevant educational system to help Baja California become an innovation powerhouse. The goal is to reach a level of economic development that is capable of successfully competing in the global economy and to allow equal opportunities for all in the context of sustainable, competitive and regionally balanced practices. Baja California has world-class companies that compete in international markets, a state government that supports research and development, as well as public and private universities of recognized quality and high level public research centers. These are home to about 508 researchers recognized by the National Research System (SNI) of CONACYT as shown in the chart below. The growth rate for prestigious researchers was an average of 10 percent annually from 2002 to 2009, which places the state atop in Mexico. The wealth of existing knowledge directed to Baja California's regional development, short, medium and long term goals, with researchers interacting among themselves through human resources training and linkages with the productive sector and government, constitutes a great local heritage.

Figure 1

## Researchers from Baja California in the National System, 2002-2009



Source: CONACYT, 2009

For the SIIDEBAJA to evolve and consolidate into a RIS, it is necessary to consider the following recommendations based on best international practices and opinions of renowned experts and researchers: a) the companies are basically the ones that create value and their relationship with HEIS is essential for the flow of information, knowledge and innovation; b) the transfer of learning from multinational corporations to regional and local companies requires specific mechanisms; c) networks and clusters as a form of business organization should be strengthened; d) in education, innovation must permeate all activities; e) strategic linkage projects should be supported with public and private venture capital; f) Institutions of mediation and support for innovation such as the Council of Science and Technology should be strengthened; g) The RIS must be driven from the highest level of government authority, and h) its leaders must be actors with high moral character, capacity and legitimacy; and i) monitoring, evaluation and benchmarking of policies to improve the RIS is essential.

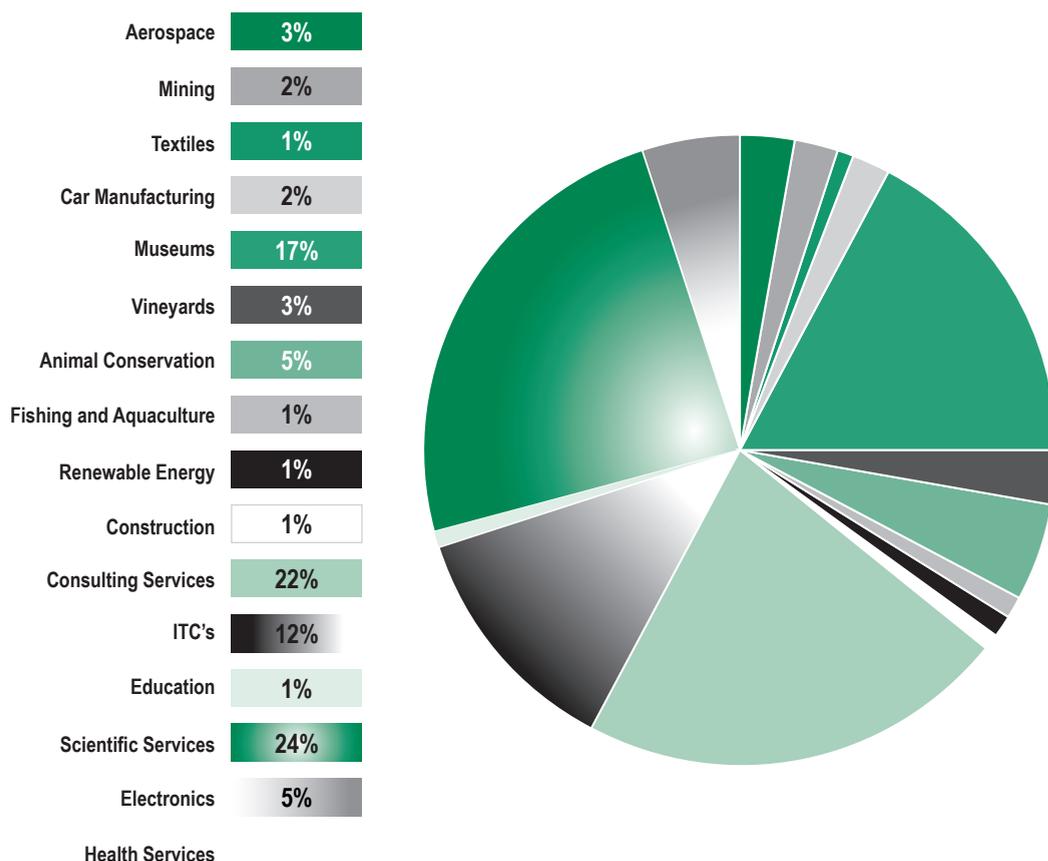
An effective policy to promote interaction and engagement between HEIS and business is the establishment of technology transfer offices and science parks. Among their main functions is legal advice on intellectual property and promoting spin-off technology companies. Their success is linked to organizational, cultural and environmental factors including agent professionalism, management style and leadership of the proponents of these initiatives, the compensation of agents and the existence of a clear strategy (Huggins et al.

2008). Under SIIDEBAJA framework the technology consortium and the Centre for Software Development are developed. The first is a joint effort between the state government of Baja California through the Council of Science and Technology (COCYT), CONACYT and the Tijuana Economic Development Council, representing the private sector, and the El Florido Industrial Park, which thus enhances its appeal with scientific and technological services for high tech companies and others. The second is a concerted effort between the State Government through ISSTECALI and COCYT, CONACYT and CANIETI (National Chamber of Industry of Electronics and Information Technology) leadership, to concentrate information technology companies in the region and give space to those created in the high-tech incubators supported by the State Government, the Ministry of Economy, higher education institutions and business organizations.

Most government activity is in the capital, Mexicali, economic activity in Tijuana and scientific activity in Ensenada. The challenge is to connect these islands of relative expertise to develop the state's competitive advantage, not only among themselves, but with the rest of the country through technology transfer practices (Figure 1). In Baja California there is a policy for business development, which is based on the "Law for the Promotion of Competitiveness and Economic Development for the State of Baja California" published in 2005 and updated in August 2010. It is a second generation business development policy, which supports previous efforts and initiatives, but emphasizes, first, the promotion of key economic sectors with greater scientific and technological activities within firms, between firms and linked to HEIS, although on the other hand, it fosters compensatory mechanisms for job creating in micro and small businesses. This effort is backed by the Mixed Funds and incentives for innovation programs that have allowed greater public and private investment in science and technology to promote competitiveness in the state. Thus, in 2009, thanks to the work linking HEIS and companies \$127.2 million pesos were placed in science and technology projects with total concurrent business of \$134 million for a total of \$261.2 million pesos, in the Mixed Fund alone. If in effect, it strengthened museums for the dissemination of science and technology, it has also impacted the infrastructure sectors such as science, information technology, electronics, construction, professional and scientific services and health services, among others (Figure 2). By August 2010 \$51.9 million pesos more were placed for a total of \$100 million, estimated to have generated \$167.8 million pesos concurrently.

Chart 2

## Joint Sectorial Impact Fund-BC, 2009



Source: COCYTBC, 2010.

Through the “Incentives for Innovation” program, chapters 2009 and 2010, 24 and 41 research and development projects by small, medium and large companies linked with HEIS, have been supported, for a total of \$75.6 and \$97.5 million pesos, respectively, which constitutes an investment growth of 29% between 2009 and 2010 in aerospace, food, pharmaceutical, agribusiness, information technology and industrial machinery, among other sectors. In total over 440 million pesos have been invested in research between 2009 and 2010 through public and private investment (Table 4).

**Table 4**  
**Investment in research and development in Baja California, 2009-2010**

|                              | Contributions in 2009 |                |                | Contributions in 2010* |                |                |
|------------------------------|-----------------------|----------------|----------------|------------------------|----------------|----------------|
|                              | Fund                  | Concurrent     | Total          | Fund                   | Concurrent     | Total          |
| <b>Mixed Fund</b>            | 127,252,079.00        | 134,007,614.00 | 261,259,693.00 | 51,866,000.00          | 167,833,143.00 | 219,699,143.00 |
| <b>Innovation Incentives</b> |                       |                |                |                        |                |                |
| <b>Innovapyme</b>            | 19,430,159.00         | 19,952,957.00  | 39,383,116.00  | 29,817,104.00          | 30,884,228.00  | 60,701,332.00  |
| <b>Proinnova</b>             | n/a                   | n/a            | n/a            | 43,555,869.00          | 24,213,685.00  | 67,769,554.00  |
| <b>Innovatec</b>             | 56,178,202.00         | 87,076,767.00  | 143,254,969.00 | 24,128,906.00          | 68,694,944.00  | 92,823,850.00  |
| <b>Total</b>                 | 202,860,440.00        | 241,037,338.00 | 443,897,778.00 | 149,367,879.00         | 291,626,000.00 | 440,993,879.00 |

\* In 2010 there is a remanent of 30 million pesos  
 Source: COCYT, 2010.

## Conclusions

While it is still not possible to speak about the existence of a properly organized RIS in Baja California, there is indeed a public policy framework with short, medium and long term goals. The PECIT (State Science, Innovation Technology Program) is the route and SIIDEBAJA is a mechanism to strengthen the links between and among stakeholders through incentives such as the CONACYT Innovation Fund and Baja California's Mixed Fund, which went from \$13 million pesos on average between 2002 and 2008, to \$100 million in 2009 and 2010.

The growing need for more resources necessary for HEIS competitiveness around the world, is faced with insufficient funding sources compared to their expectations. In Sweden, over 50 percent of resources for research and development in HEIS comes from external sources. In Japan and Korea, declining government resources for HEIS was compensated through partnerships and linkages with the private sector which increased investment in research and development (Chen and Kenney, 2007).

The success of technology transfer in Finland, since the nineties, is based on the rapid shift toward intensive growth knowledge environments. The R&D efforts in the long term, have been jointly carried out by industry and HEIS, but a key factor has been the strong investment in R&D by the private sector, as it accelerated the growth of the public sector through joint activities and policies (Rubiralta, 2003).

The world today is increasingly complex and uncertain, with a growing number of stakeholders demanding more from the scientific and educational sector. In a society with a clear regional differentiation (Howells, 1999), people working in HEIS, along with government officials and business sectors, are looking at regions in Mexico and Baja California, beyond the strai-

tjackets imposed by economic constraints and political terms. Future scenarios should promote reflection on the major changes that need to happen in the HEIS and their extended environment. What do Baja California HEIS need to do to support the RIS in the context of global competitiveness? Re-define their teaching strategies, reduce operating costs and increase funding for research and innovation projects and practices; emulating best practices of other institutions through interaction, increase the flexibility in all their processes of continuous improvement; and increase their impact seeking co-financed resources to solve local and regional problems. The main change is that the production and dissemination of knowledge is becoming less of a quasi-monopolistic activity self-contained in isolated HEIS. The profound challenge for HEIS is that the training and education of students is to occur increasingly connected to their environments, so that knowledge is produced where needed, while HEIS should gather intellectual resources from business and government to interact in a distributed system of knowledge through a common language. Departing from the premise that the most competitive regions have the best HEIS and bet on their development as pillars of social, economic and regional development (Ramos and Plascencia, 2010).

The world is rapidly changing, we live in exponential times (Kurzweil, 2005). In Mexico as in most of the world, we are preparing students for jobs that do not yet exist, that will use technologies not yet developed and solve problems that have not yet been identified. This is shown by training in new careers such as bioengineering (engineering applied to biology and chemistry), nanotechnology (nanoparticle technology) and renewable energy, among others (Plascencia et al., 2008). In the knowledge economy the first task for regional development policies is to promote learning processes and interaction between systems, subsystems, organizations, and individuals that would enable sustainable economic and social development.

## References

- Cooke, P. (1992). "Regional innovation systems: Competitive regulation in the new Europe", en *GeoForum*, 23, 365-382.
- Cooke, P. (2001). "Regional innovation systems, clusters, and the knowledge economy", en *Industrial and Corporate Change*, 10(4), 945-974.
- Chen, K. y Kenney, M. (2007). "Universities/Research institutes and regional innovation systems: The cases of Beijing and Shenzhen", en *World Development*, 35(6), 1056-1074.
- Etzkowitz (2003). "Innovation in Innovation: The Triple Helix of University-Industry-Government Relations", en *Social Science Information* 42 (3), 293-338.
- Foro Consultivo Científico y Tecnológico, A. C. (2009). *Estadísticas de los sistemas regionales de innovación* (Vol. I y II). México, D. E.: FCCT, A. C.
- Gibbons, M. (1997). *What kind of University? Research and teaching in the 21<sup>st</sup> century*. 1997 Beauland lecture. Victoria University of Technology.
- Gibbons, M. (1998). *Higher Education Relevance in the 21st Century*. Education. Washington, D. C., The World Bank.
- Howells, J. (1999). "Regional Innovation Systems?" In *Innovation Policy in a Global Economy*. Cambridge University.

- Huggins, R., Johnston, A., y Steffenson, R. (2008). "Universities, knowledge networks and regional policy", en *Cambridge Journal of Regions, Economy and Society*, 1(2), 321-340.
- Kurzweil, Ray. (2005). *The Singularity is near. When humans transcend Biology*. Londres, Viking Penguin Group.
- Lundvall, B-A. (1992). *National systems of innovation: Towards a theory of innovation and interactive learning*. Londres y New York, Pinter.
- Mowery, David y Bhaven Sampat (2005). "Universities in national innovation systems", en *The Oxford handbook of innovation*. Nueva York, N. Y., Oxford University Press.
- Mungaray y Palacio (2000). "Shumpeter, la innovación y la política industrial", en *Comercio Exterior*, Vol. 50 (12) Pp. 1085-1089.
- Nelson, R. R. (1993). *National innovation systems: A comparative analysis*. Oxford, Oxford University Press.
- Nelson, R. y Rosenberg N. (1993). "Technical innovation and national systems", en R. R. Nelson (Ed.), *National innovation systems: A comparative analysis*. Nueva York, N.Y., Oxford University Press.
- OECD (2009). *Reviews of regional innovation. 15 Mexican states*. París, Organisation for Economic Cooperation and Development.
- OECD (2008). *Higher education, management and policy. entrepreneurship*. París, , Organisation for Economic Cooperation and Development
- Plascencia, Ismael et al. (2008). *Estudio de Factibilidad de la Carrera de Bioingeniería*. Universidad Autónoma de Baja California.
- Ramos, Jorge e Ismael Plascencia (2010). "Una visión desde Baja California de la ciencia, tecnología e innovación", en *Ciencia Tecnología Innovación*, Núm. 103. Nuevo León. Gobierno del Estado de Nuevo León. Pp 11-13.
- Rubiralta, Alcañiz, M. (2003). *Transferencia a las empresas de la investigación universitaria*. Madrid, Academia Europea de Ciencia y Artes.
- SIIDEBAJA (2009). *Sistema de Investigación, Innovación y Desarrollo Tecnológico de Baja California*, Mexicali, B.C., Periódico Oficial del Estado de Baja California, Tomo CXVI, núm. 14, 20 de marzo.
- Storper, M. (1997). *The regional world*. Nueva York, The Guilford Press.
- Vincent-Lancrin, S. (2006). What is changing in academic research? Trends and futures scenarios. *European Journal of Education*, 41 (2), 169-202.