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BUILDING OF THE CLUSTER SOFTWARE IN THE REGIONAL DEVELOPMENT OF BAJA CALIFORNIA, MEXICO

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Abstract

The economic literature has made clear the benefits of clusters in order to articulate an innovative context and accelerate the growth of the industry. The search for effective strategies for creating clusters remains an elusive goal, so the study of experiences on their construction is important. In this research, the cluster formation of the Information Technology and Communication sector in Baja California, Mexico, is analyzed, from a geographical agglomeration view, the business interaction with the government and its relationship with higher education institutions, through different experiences of cluster formation, driven on a triple helix under the scheme of the regional innovation system promoted by the Science, Technology and Local Innovation Act, which seeks to consolidate different clusters, which would help to competitively articulate the regional economy.

INTRODUCTION

The analysis of regional development is related to economic concepts such as innovation, economic growth and welfare. In the search for higher level of regional development, the number of communities in a given region tend to increase, strengthening or managing new local capacities to improve their competitiveness. The natural result of the latter mention efforts is a competitive differentiation at a regional level, supported in strengthening the existing productive potential, which could also define the specialization of areas in which benefits may be achieved through agreements and strategic assignment of private and public resources. Regarding this specialization process, research from the agglomeration of Marshall to the Porter cluster shows a growing use of economic specialization capabilities needed to achieve greater regional competitiveness, based on interaction with government institutions (IG), Higher Education Institutions (IES) and research centers (CI).

In the last two decades, the study of clusters has become relevant, as an organizational framework that offers simplicity for competitive implementation of public policies at national and local level, seeking to improve their environment. The United States and the European Union researchers have contributed the grand majority of studies on the issue [6].

The objective of this work is to contribute to the research of cluster building of ICTs in the region of Baja California, from underlining their characteristics, organization and the illustrating the evolution of the initiatives involving ICTs. Therefore three specific objectives are addressed: Identify geographical clusters of ICT companies, examine the interaction between companies in the ICT sector and the government, through various supports or by participating in strategic alliances; and the study of the interaction of companies with IES and CI through Incentives Program for Innovation (PEI) and the particular experiences of cluster building projects.

Despite the importance of the identification exercise , and even the relationships in the value chain through the input-output [9], there are questions about the interaction of economic factors and agents due to the transversal nature of the system. The industry shows a very atomized and agglomerated formation by market forces, which translates into a strong rivalry expressed in a high participation in the IEP and an organizational capacity to remake permanently in different ways. Moreover, the constant participation of Baja California's state government (GEBC) is stressed in promoting local cluster and the ability to learn from the government, as well as the representative

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business organization, higher education institutions and enterprises.

The main limitations of this study are: the data it uses, which is the 2009 Economic Census; which does not yet have information on the impacts of the projects that competed in PEI in 2012 and 2013, also, the initiatives IT @ Baja, CENI2T, Softtek and UABC-BIT Center, require behavioral studies of a deeper kind that are not made in this paperwork.

In the background section the ICT industry in Baja California, which is divided into manufacturing activities and services, is contextualized through indicators of production, employed personnel and company size, as well as with a comparison with the rest of the country. At the same time the institutional framework of ICTs in Mexico and Baja California is clarified, where, the institutional impetus to the activities of science, technology and innovation stand out.

In the Methodology section, the theoretical framework is discussed; the sources of information are specified, such as Business Development Policy (EDP), the Special Program of Science, Technology and Innovation (PECIT); and the use of the collected information is also discussed.

In the Results section, the agglomerations of the ICT companies located in Baja California is analyzed; the dynamism of the industry in the quest for innovation and participation in the amounts contested in PEI; and the evolution of various experiences of international, national and local technology clusters are detailed, which have tried to organize the industry. Finally, the Conclusions section highlights the continued State support for the formation of ICT clusters in Baja California and the evolution of the actors of the triple helix.

The ICT industry of Baja California in the national context

In 2013 the ICT industry in Baja California consists of 1022 companies, of which 14% are manufacturers (where 58% of these are over 101 employees) and 86% are services providers (where 81% have fewer than five employees) (see Table 1).

Table 1. The ICT industry by company size

Employees	Manufacturing	% from total	Services	% from total	Total	% from grand total
0-5	8	6%	713	81%	721	71%
6-10	5	3%	81	9%	86	8%
11-30	9	6%	56	6%	65	6%
31-50	12	8%	10	1%	22	2%
51-100	26	18%	8	1%	34	3%
101-250	29	20%	3	0%	32	3%
251 and above	55	38%	7	1%	62	6%
Grand Total	**144**	**100%**	**878**	**100%**	**1022**	100%

Source: National directory of economic units from INEGI http://www3.inegi.org.mx/sistemas/mapa/denue/default.aspx

Altogether, 71% of companies have less than 5 employees and 80% have less than 10. For the manufacturing sector, 76% of companies have 50 or more employees, and for the service sector 96% have fewer than 30 employees.

At the level of specific weight, 14% of manufacturing companies made 64% of the production value of the industry, the subsectors with the highest participation are manufacturers of audio and video equipment with 29%, manufacturers of electronic components with 17% and manufacturers of computers and peripheral equipment with 10%, altogether the add up to 56% of the total (see Table 2).

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Table 2. GDP of the ICT industry (manufacturing) and participation in the added State

Subdivision	Total gross production (thousands of dollars)	%Manufacturing	% TIC´s	% Total gross Production State
Manufacture of other machinery and equipment for trade and services	13,569	1%	1%	0.06%
Manufacture of computers and peripheral equipment	257,071	16%	10%	1.11%
Manufacture of telephone equipment	13,457	1%	1%	0.06%
Manufacture of transmission and reception of radio and television, and wireless communication equipment	88,094	5%	3%	0.38%
Manufacture of audio and video	737,259	45%	29%	3.18%
Manufacture of electronic components	432,177	27%	17%	1.86%
Manufacture of measuring instruments, control, navigation and electronic medical equipment	66,020	4%	3%	0.28%
Manufacture of electrical conduction cables	15,829	1%	1%	0.07%
Subtotal Manufacturing	**1,623,476**			6.99%

Source: National directory of economic units from INEGI, http://www3.inegi.org.mx/sistemas/mapa/denue/default.aspx

Meanwhile, the service sector has a 36% of total production in the sector, with two subsectors concentrating 30% of the production: wireless carriers, except satellite services, with 17% and Wired telecommunications operators, excepting subscription, with 13% (see Table 3). These five subsectors, three in manufacturing and two in services, account for 87% of the total production value of the ICT industry, which in turn represents about 11% of total production in the state.

Table 3. GDP of the ICT sector (services) and participation in the added State (BC)

Subdivision	Total gross production (thousands of dollars)	% Services	% TIC´s	% Total gross production State
Editing software and editing software integrated with reproduction	12,998	**0%**	**0%**	0.00%

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Wired telecommunications operators, except by subscription	5,266,995	**36%**	**13%**	1.42%
Wired telecommunications operators subscription	820,019	**6%**	**2%**	0.22%
Wireless carriers, except satellite services	7,166,384	**49%**	**18%**	1.93%
Satellite telecommunications services	6,522	**0%**	**0%**	0.00%
Other telecommunications services	526,286	**4%**	**1%**	0.14%
Electronic data processing, hosting and related services	25,705	**0%**	**0%**	0.01%
Publication and distribution of content exclusively through Internet search services on the network		**0%**	**0%**	0.00%
Other information provision services		**0%**	**0%**	0.00%
Rental of computer equipment and other machinery and office furniture	54,679	**0%**	**0%**	0.01%
Services computer systems design and related services	407,192	**3%**	**1%**	0.11%
Repair and maintenance of electronic equipment for domestic use	294,012	**2%**	**1%**	0.08%
Repair and maintenance of other electronic equipment and precision equipment	115,040	**1%**	**0%**	0.03%
Total Services TIC´s	**14,695,831**			3.96%

Source: National directory of economic units from INEGI, http://www3.inegi.org.mx/sistemas/mapa/denue/default.aspx

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In terms of employment, the manufacturing industry accounts for nearly 90% of employed people, while the services sector slightly more than 10% (see Table 3). Hence, these data contrast with the weights of production value, because although manufacturers produce 64% and services 36%, despite their different weights, productivity in the services sector compared to the manufacturing industry goes from 3.3 to 0.7. The subdivisions with the more staff employed are: the audio and video manufacturers along with that of electronic components, both with 36% in the field of manufacturing, and wired telecommunications operators, except for subscription wireless carriers and satellite services, both have a 5% in the field of services.

Table 4. Population occupied by the ICT sector

	Occupied Persons	% Man. TIC´s	% TIC´s
Manufacturing			
Manufacture of other machinery and equipment for trade and services	765	1%	1%
Manufacture of computers and peripheral equipment	2,148	3%	3%
Manufacture of telephone equipment	627	1%	1%
Manufacture of transmission and reception of radio and television, and wireless communication equipment	5,569	8%	7%
Manufacture of audio and video	28,915	40%	36%
Manufacture of electronic components	29,092	40%	36%
Manufacture of measuring instruments, control, navigation and electronic medical equipment	4,075	6%	5%
Manufacture of electrical conduction cables	1,291	2%	2%
Subtotal Manufacturing TIC´s	**72,482**		89.67%
	Occupie Persons	**% Ser. TIC´s**	**% TIC´s**
Services			
Editing software and editing software integrated with reproduction	11	0%	0%
Wired telecommunications operators, except by subscription	2,327	28%	3%

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Wired telecommunications operators subscription	910	11%	1%
Wireless carriers, except satellite services	1,484	18%	2%
Satellite telecommunications services	11	0%	0%
Other telecommunications services	226	3%	0%
Electronic data processing, hosting and related services	785	9%	1%
Rental of computer equipment and other machinery and office furniture	218	3%	0%
Services computer systems design and related services	883	11%	1%
Repair and maintenance of electronic equipment for domestic use	884	11%	1%
Repair and maintenance of other electronic equipment and precision equipment	614	7%	1%
Subtotal Services TIC´s	**8,353**		10.33%

Total Sector TIC´s 80,835

Source: National directory of economic units from INEGI, enhttp://www3.inegi.org.mx/sistemas/mapa/denue/default.aspx

When analyzing the participation of ICTs in the national GDP, 8 states account for 74% of the value of national production industry, 5 of which are in the northern border (Nuevo Leon, Chihuahua, Baja California, Tamaulipas and Sonora) and produce 31% of GDP in ICTs. If Coahuila is included, the 6 northern Border States produce 33% of the total GDP of the sector (see Table 5). When the results of manufacturing and disaggregated services are observed, Chihuahua and Baja California have a similar structure in their participation, since manufacturing is predominant in both cases with a 16% of total production and 4% of services. Meanwhile, Nuevo Leon has a 9% and 7% respectively.

Table 5. Main States that contribute to the national GDP of ICTs, 2009

State	% Man.	% Ser.	% Total	% GDP
Mexico City	3%	35%	27%	1.370%
Jalisco	17%	6%	9%	0.456%
Nuevo León	9%	7%	8%	0.400%
Chihuahua	16%	4%	7%	0.368%
Estado de México	7%	7%	7%	0.349%
Baja California*	16%	3%	7%	0.345%
Tamaulipas*	11%	3%	5%	0.253%

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Sonora*	6%	3%	4%	0.183%
Total	84%	68%	72%	3.724%

Source: INEGI, economic Census 2009. www.inegi.gob.mx

Regarding the employed personnel, Chihuahua occupies 15% of ICT personnel in the country, with a share of 23% in manufacturing and 7% in services, while Baja California does with 23% in manufacturing and 3% services. This means that with ten thousand less workers in the service sector, the production value is about the same level as in Chihuahua, which means greater specialization in the services sector in Baja California and therefore higher productivity per person employed (see Table 6).

The second place in occupied staff is Distrito Federal with 14%, 1% in the manufacturing area and 29% in the services area. Despite the numerical proximity to Baja California, the main difference is observed in the pesos invested in manufacturing and services. Meanwhile, Nuevo Leon manufactures 60% of what is produced in Baja California with only 22% of staff, which indicates that the manufacturing being done in Nuevo Leon is technology intensive and therefor has a higher value-added. The same is observed in the services sector of Nuevo Leon, producing more than twice as Baja California with only 42% of staff working in the latter.

Table 6. Main States to hold staff in the ICT industry

State	% Man.	% Ser.	% Total
Chihuahua*	**23%**	**7%**	**15%**
Mexico, City	1%	29%	**14%**
Baja California*	**23%**	**3%**	**14%**
Tamaulipas*	**18%**	**3%**	**11%**
Jalisco	13%	6%	**10%**
Nuevo León*	**5%**	**7%**	**6%**
Sonora*	**8%**	**3%**	**6%**
Estado de México	2%	7%	**4%**
Total general	**94%**	**64%**	**80%**

Source: INEGI, economic Census 2009. www.inegi.gob.mx

The above indicators show that despite the importance of the ICT industry in Baja California, the current weights used in manufacturing and services in terms of value of production, employed personnel and resulting productivity, the services sector has a greater growth potential. This is because, it has higher levels of productivity and dynamism, in line with the current trends in specialized and added value.

ANALYTICAL, METHODOLOGICAL FRAMEWORK AND DATA SOURCES

Alfred Marshall was the first to explain the mechanism of industrial agglomeration of an industry. The nearby location of resources for business produces proximity effects that are denominated as economic externalities [18]. Such externalities include: a) the transfer of skills and inventions among colleagues, competitors and generations; b) the emergence or growth of supplier industries to the central industry, specializing in supplies and services; c) the benefits of scale by sharing specialized machinery; and d) the concentration of skilled labor.

Jacobs [13] analyzed how the proximity of several business activities of different fields give rise to new types of businesses; and how this in turn affects economic growth in cities. From Marshall and Jacobs contributions, it can be deduced that if economic clusters exist, then there must be proximity effects, which serve to achieve and maintain the growth of enterprises and regions [15,4].

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Innovation resulting from spatial agglomeration processes generates what is known as Regional Innovation System [1]. Like the national innovation systems [16,3], the SRI operates with a systemic spatial approach and are based on the ways in which different types of actors (companies, CI, and IG) work to develop new knowledge, new applications and new production skills. Its operation relies largely on regional production infrastructure, allowing it to build itself as a region of learning and innovation [29].

The strong risks of acting individually against the forces of globalization strengthen the practice of creating new forms of business strategy for regional development. To promote or consolidate clusters on a creative and strategic way with companies of different sizes and capacities, and to recognize that their employers have different possibilities to invest and learn [21], complicates the study of clusters. This has taught us that various factors help or hinder its development over time and leads to a life cycle consisting of four phases [23].

A triple helix model stems from the fact that the joint work of three key economic players, such as university, government and the productive sector, generate higher results than if they worked separately [8]. This style of work focusing on cooperation in innovation, productivity and competitiveness, allows to cope with market diversification, strong competition and technological advances generated by consumers with more demanding and selective needs. These three key players, though operating with different incentives, converge at a point in a value chain, where the generation of knowledge applied to the needs of the company allows optimization of resources while seeking the satisfaction its needs and the clients. Regionally, this would mean that industrial policies operate through a research and development policy, from training the workforce and promoting competition, which helps to improve the productive environment [21].

The IESs have been characterized for providing knowledge that supports innovation in the company through trained personnel and research results. However, it shows gradually how the IESs become managers or catalysts for the formation of new companies based on the use of new technologies originating from academic research [27]. This shows that universities are evolving from being institutions of learning to spaces where teaching is combined with research, leading to intellectual capital taking an increasingly important role in economic growth [2]. This phenomenon is observed not only in the United States but in many other countries [8]. The merging process has proven to be creative and productive [7]. Its value is observed when in addition to tangible goods, the potential for innovation is noticeable not just from the perspective of the company, but also from the emergence of business interests that combine academic research with its application [20].

In this process, the IESs emerge as an equal partner in the Triple Helix. The reasoning is that the relationship of these three is the key to improving the conditions for innovation and competitiveness in a society increasingly based on knowledge. The company operates where production takes place, the government guarantees the interaction and cooperation through encouragement and incentives for compliance with contractual relations, and the university is the leading provider of knowledge and technology [26,28].

The active role of universities and governments show that entrepreneurship is not a characteristic that belongs only to businesses. Entrepreneurial universities have a key role in the triple helix through technology transfer, incubating new businesses, assuming regional leadership to identify the needs and opportunities in the market and react quickly with relevant study plans [8,5].

Since 2002, the first Entrepreneurial Development Policy was developed in Baja California. It was a product of government vision and the productive sector of directing the state in search of ways to improve the social conditions of the habitants and its future generations, in a global context. Under this scenario, economic agents require clarity of the changes necessary to improve the quality of life, from the ability of companies to produce wealth for communities. In this first edition, PDE only considered Tijuana ICTs as a Strategic Key Area for structuring a productive chain revolving around productive projects related to the San Diego software cluster, which eventually would create a computing processes cluster.

By using the States' input-output matrix Fuentes and Martinez [9,17] evaluated the role that each sector had in the economic system and the possible outcomes. Their findings indicate that clusters may be starting to influence starter cores in a technological and industrial modernization for the State, both for greater local impact and for the ability to contribute immediately to the definition and

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consolidation of regional production structure; as well as to define and promote the regional productive vocations and the assignation of municipal priorities with criteria that would allow proper decision making.

Since PDE in 2002, government worked on conceptualizing and organizing eight clusters. For 2008 we worked with fifteen clusters that show an orientation towards the application of technologies such as the case of the aerospace industry, biotechnology, logistics, information and communication technologies and medical services [32]. The latter industries involve a high added value in technology, development and innovation; creating jobs for a highly qualified staff with high salaries; and they are highly valued by being highly competitive and innovative. Consequently, their development demands for specialized human capital and link with the academic sector and the government as a catalyst.

The consolidation of clusters supports the development of other clusters in activities where possible synergies exist, depending on the physical infrastructure and industrial organization [17]. To achieve the objectives of the EDP, we were required to align the Special Program of Science, Technology and Innovation 2009-2013 with the development of industries using high technology and innovation, and higher value-added production through: a) business services for the competitiveness; b) scientific and technological infrastructure; c) focus on MSMEs and value chains; d) financing; and e) strategies for science and technological innovation that allow clusters of selected industries to work on an agenda strategic innovation [31].

The identification of a cluster is achieved through quantitative analysis to identify concentrations of industries in the same region. The location quotients are the starting point for identification, while the input-output tables allow analysis of vertically integrated clusters [25]. However, this type of analysis does not measure the flow of information and forms of cooperation established by non-market linkages. A qualitative analysis allows a more complete picture of the interactions that are established within the clusters and their external linkages [19].

In order to identify clusters of the ICT sector in Baja California, the enhanced platform of the Digital Map of Mexico, created by the Department of Geography and Environment of INEGI was used. These maps allow visualizing the economic units in cartography; knowing the geographic coordinates of your approximate location; and permit visual location of existing agglomerations. Subsequently, in order to identify the interaction of ICT companies in Baja California, first-hand information was obtained on ICT companies which benefit within the PEI, the National Council of Science and Technology (CONACYT), corresponding to the time period 2009-2013. This program operated by SEDECO in Baja California through the State Council of Science and Technology of Baja California (BC COCYT) which provides additional competing economic resources for companies that develop research, technological development and innovation in collaboration with IES and / or CI. All of the above seek to achieve the biggest impact on the competitiveness of the regional economy [22].

This information can identify a relationship between HEIs and ICT companies, as companies prefer to increase the amounts requested. Finally, to deepen the relationships between ICT companies, IES and IG, the process of building the ICT cluster is done through the analysis of different experiences of early programs that were implemented.

RESULTS ANALYSIS

The geographical location of the 1022 companies in the state of Baja California, concentrate on the cities of Tijuana and Mexicali with 46% and 32% respectively (see Table 7). In Tijuana, of the 483 ICT companies, 54% are located within 5 km and 86% within 10 km. In Mexicali, of the 323 ICT companies, 90% are located in within 6 Km. On the other hand, of the 149 ICT companies in Ensenada, 90% are concentrated in the city center primarily within 5 km. In the case of Tecate, the 47 companies of ICT are located within 4 km, while in Playas de Rosarito, 95% of the 20 ICT companies are located within 5 km. Summing up the 86% of the state industry it is agglomerated within 5 km, which means there is a strong focus on scope economies through cooperation and learning.

Table 7. ICT Companies per City

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City	TIC´s Firms	% Total
Ensenada	149	15%
Mexicali	323	32%
Playas de Rosarito	20	2%
Tecate	47	5%
Tijuana	483	47%
Total	**1022**	

Source: INEGI. DENUE. http://www3.inegi.org.mx/sistemas/mapa/denue/default.aspx

For the 2009-2011 period, of the 222 projects that the PEI received, 77% were concentrated in the eight strategic economic sectors of Baja California (see Table 8) and 42 projects (1 out of 5) from ICT were able to locate a dynamic sector of the regional economy. On the other hand, when analyzing ICT projects accepted by the PEI between 2009 and 2013, an annual average of nearly 10 approved projects was observed, with an average annual cost of 20 million (see Table 9).

Table 8. Main sectors in search of PEI support according to their common

Area	Projects
Information technology	42
aerospace	33
agribusiness	26
pharmaceutical	19
electronics	18
automotive	13
foods	11
biotechnology	9
Total Projects 2009-2011	**171**

Source: Data from COCYTBC (2013)

Table 9. ICT projects benefiting from the PEI and company stratum

Year	Projects accepted	Amount of financing	Average amount of financing per project	Company size		
				Micro	Small	Medium
2013	8	35,932,325	4,491,541	2	4	2
2012	12	12,621,445	1,051,787	6	6	0

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2011	10	23,816,977	2,381,698	6	4	0
2010	12	18,608,550	1,550,712	7	5	0
2009	6	5,411,397	901,900	1	4	1
Total	**48**	**96,390,693**	**2,008,139**	**22**	**23**	**3**

Source: Data from COCYTBC (2013)

The behavior between the approved projects ratio and the average amount of the fund draws attention, mainly since even with the same amount of projects approved in 2010, 50% more resources were delivered on average in 2012. The fact that there were 2 less projects in 2013 than in 2011 with 50% more resources, has to do with two projects from medium enterprises being integrated, with stronger investment requirements, while in 2011 most of the projects were for micro and small enterprises. Of the 48 approved projects, 46% were for microenterprises, 48% for small firms and 6% for medium enterprises. The absence of approved projects for large companies seems like an indication that the competitive structure of the industry is concentrated on MSMEs.

As for the projects approved by city, Tijuana stands out at 63%, with Mexicali at 27% and Ensenada with 10%. On average, between 2009 and 2013 there were 6 projects accepted in Tijuana, Mexicali with 2.6 and Ensenada 1.25. Table 10 shows that by 2013 Tijuana had support with above average amounts, and since the average support per project was an average four million, Tijuana averaged five and a half million.

Table 10. ICT projects benefiting from the PEI per city and average amounts per project

City		2009	2010	2011	2012	2013	Total
Ensenada	Projects	1	2		1	1	5
	Average amount/project	958,650	2,156,700		733,750	740,000	4,589,100
Mexicali	Projects	3	5	2	2	1	13
	Average amount/project	2,841,481	5,999,543	6,217,500	3,815,770	1,865,000	20,739,294
Tijuana	Projects	2	5	8	9	6	30
	Average amount/project	1,611,266	10,452,307	17,599,477	8,071,925	33,327,325	71,062,299
Grand Total		**6**	**12**	**10**	**12**	**8**	**48**
		901,900	**1,550,712**	**2,381,698**	**1,051,787**	**4,491,541**	**2,008,139**

Source: Data from COCYTBC (2013)

As for the total amounts approved between 2009 and 2013, from just over 96 million, Tijuana had a 74%, Mexicali 21% and Ensenada 5%. Another indicator of the dynamism of the ICT companies looking for innovation in Baja California, Tijuana had 50% of projects based on Innovapyme mode and

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50% in Proinnova mode; in Ensenada only 25% are Proinnova proyects and Mexicali an 18%. To the extent that the projects require a mandatory Proinnova mode collaboration between companies and higher education institutions, it is a good proxy indicator of high culture of collaboration in Tijuana (see Table 11).

Table 11. PEI mode support per city

City/PEI Modality	2009	2010	2011	2012	2013	Total general
Ensenada	1	2		1	1	5
INNOVAPYME	1	2		1		4
PROINNOVA					1	1
Mexicali	3	5	2	2	1	13
INNOVAPYME	3	5	2	1		11
PROINNOVA				1	1	2
Tijuana	2	5	8	9	6	30
INNOVAPYME	2	4	4	1	4	15
PROINNOVA		1	4	8	2	15
Grand Total	**6**	**12**	**10**	**12**	**8**	**48**

Source: Data from COCYTBC (2013)

As for the behavior of ICT companies on their participation in approved projects and the total amount received from PEI 2009 to 2013, in Baja California, the average share equals 30%, with a minimum 24% in 2009 and up to 36% in 2011. Moreover, the average amount of support was 21%, with a minimum of 7% in 2009 and up to 36% in 2013.

Discussing the institutional building process of ICT cluster

In the early years of this century, Baja California started a movement in the software industry with features of an institutional dynamic promoted by the Entrepreneurial Development Policy (EDP). It was an initiative of businessmen associated in 2004 to compete in the Southern California market through what they called Cluster IT (IT @ Baja). While their efforts and organization were positive, the results showed that this organization was more focused on training and certification actions based on public support than to strengthen their business relationships [12].

The Integration Centre of Technological Innovation (CENI2T) project was developed by the Center for Scientific Research and Higher Education of Ensenada during September 2004 and July 2005. It was created under the auspices of the Ministry of Economy, through the Prosoft program, as part of its policy to trigger development initiatives in the regions with the greatest potential and capacity for sustained dynamics of local and sustainable innovations. The project was supported by SEDECO who contributed concurring funding to implant the capabilities of an innovative regional center for world class leading to the acquisition, transfer and development of technology skills in the economy of Baja California.

In an analysis that was conducted in late 2008 and early 2009 about the lack of sustainability, two factors stand out: first off, the project had no business engagement despite being designed to detonate the sector in the area of ICTs. The second, the lack of discipline for timely annual closure of projects, limiting the management of additional resources for subsequent periods. As the project was never considered a priority, its impact on the national and local employment in the medium term toghether with the level of economic and social return was questionable and SEDECO settled the financial commitments and finally canceled it in early 2009.

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In April 2006, Softtek opened a Center for Global Development (CGD) software within the premises of the Autonomous University of Baja California (UABC) in the Ensenada campus. As a global provider of ICT services and business processes, he was the creator of the Nearshore model [33], which consists of ICT services that are delivered to customers from a country adjacent or close to the final destination. It is one of two companies in the region certified by Capability Maturity Model Integration (CMMI) with the highest level of the standard developed by Carnegie Mellon University [11].

The UABC-SOFTTEK agreement was supported by SEDECO, based on the model of relationship, which favors the incorporation of professionals guests involved as teachers and who apply their professional experience in the integral formation of the future professional and streamline the academic work of the institution [35]. In the agreement, it was specified that the collaboration between the company and the university would be articulated through the University Center for the Development of ICT (CUDTI).

SOFTTEK supported itself with the participation of federal and state funds and UABC participated with the infrastructure, students and teachers, while the company provided customer contracts and advice. Three phases for the development of activities were defined: the physical adequacy of facilities and the review of academic training activities related to ICTs; the construction and refurbishment of physical spaces and attracting financial resources to achieve self-operation; and the construction of a building conditioned on the realization of economic and self CGD funds.

Thus Softtek and UABC have created a partnership to align the curriculum of academic programs and expose students to world-class projects by participating in the Momentum program and help them better improve in their careers. Softtek began with a1.4 million dollar investment and by the end of 2006 had more than 200 developers. This positioned the UABC as an institution that easily adapts it curriculum towards the potential demand of the ICT cluster by creating graduate programs and the signing of agreements so that students are trained in the company and, if applicable, hired by it [12]. In 2013 Softtek expanded its operations in a warehouse in El Sauzal, Baja California and terminated its successful incubation at UABC.

Although, there were limited results in the building of the ICTs cluster in the region, in 2009 the Northwest delegation of the National Chamber of the Electronics Industry of Telecommunications and Information Technology (CANIETI), together with SEDECO, supported the creation of a Software Center since, besides being one sector needed to incubate in the PDE, previous experiences show a major business movement in the sector due to the conditions of local and cross-border markets which were demanding services related to ICTs.

Local experiences were analyzed in relation to other experiences in which CANIETI had participated in the west, south and northwest of the country and concluded that the triple helix model was still in force, but that the participation of the three sectors needed to be effective through a combination of market mechanisms and government to ensure the sustainability of efforts to institutionally organize a cluster of ICT's which naturally tended to agglomerate.

With this in mind and with the support of CONACYT, the Government of Baja California, UABC, and CANIETI, the BIT CENTER (Baja's Innovation and Technology Center) project was generated in Baja California. For this, the COCYT issued a demand priority in the call for Mixed Funds from CONACYT - Baja California 2009-1, where the CANIETI- driven Software Center project presents competition to host companies, associations, academic and research centers related to the ICT industry operating in Baja California. This concentration on the same physical space, would share knowledge, experience, cost, image, and infrastructure services and create positive synergies for participants. The objectives, that other similar centers in the country don't have, are developing training areas and generate areas of coexistence for independent professionals (freelancer) engaged in the technology development. BIT CENTER management is made through a civil association of triple helix where Northwestern CANIETI, UABC and Mexico First are involved. With the same formula but on UABC facilities, this project expanded in Ensenada with an investment of 6.5 million pesos [10,30], in the modified space to incubate Softtek in early 2013.

As a priority of the revised PDE, this project was given the go ahead by SEDECO COCYT, ISSSTECALI and Northwest CANIETI. The presence of the latter, led to a visit from the other three actors to the Software Center facilities in

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Guadalajara in order to visualize the potential of a center of its kind in the city of Tijuana. After identifying its potential and watching its profits, the search began for a place to host it and an ISSSTECALI owned property located in an area of high concentration of ICT companies was chosen in early 2009, with an ample parking that would allow the project sustainability through rental value.

The four main axes that guide the activities of the center are: Strengthening the SME industry; generate linkage programs between HEIs and the productive sector; generate solutions that increase the use of technology in the community; and encourage the vocations of middle and high school students for careers focused on the study of science and technology.

The central location of the BIT Center on a boulevard with many access points from the United States puts it right in the middle of the two largest crowd sectors of the services of the ICT industry in the city of Tijuana. Considering a 5 km radius around the BIT Center, 54% of service companies are located; and 86% of the companies as well if the radius is increased to 10 km (see Frame 1).

Frame 1. Agglomeration of service companies in the ICT industry

Source: National directory of economic units from INEGI, http://www3.inegi.org.mx/sistemas/mapa/denue/default.aspx

On February 15, 2010 the establishment of the Center for Information Technology of Baja California was formalized as a Civil Association, which besides the directive board also includes the associates' figure which are classified as assets and benefactors. The investment for the development and implementation of the project fund was about 41 million pesos and the expected results would be: the promotion of regional development and the ICT sector as a priority [24] and as a strategic area of development in the 2002-2008 PDE; the consolidation of higher quality infrastructure and capacity that could access each company individually; promoting an export platform for micro and small enterprises in ICT; and employment generation projects to increase business and personnel employed with higher added value.

BIT Center began with 30 companies at the end of its first phase in September 2011 and towards May 2014 had 49 companies employing about 300 people with the potential to increase its personnel to 900. Of these 49 companies, 25 (51%) belong to the ICTs industry in the service sector, of which 16 are devoted to software development, 5 are marketers of software, 2 are dedicated to the rental of computer equipment and 2 provide hardware solutions with specialized software included. The other 24 (49%) are focused on the support of administrative processes or the development of mainly business marketing.

FINAL THOUGHTS

To analyze the differences and regionally contextualize the crowds of the ICT companies in the sector can generate inputs for the decision-making of public policy makers, entrepreneurs and potential investors in local areas of opportunity as well as possible synergies between actors to help the development of the industry. The ability to integrate ICTs to the rest of the economic structure, and the

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permeation throughout society, allows the use of these technological tools help higher productivity and optimal use of resources, strengthening the competitiveness of the region.

The ICTs cluster in Baja California has a strong potential, built therefore by business opportunities, such as the expectations and consensus reached in the context of the PDE, which is identified as an area for hatching. Consequently, one can say that the current ICT industry is a product of an ongoing effort by the private sector, the academy and the government, which has been evolving since 2003, with the SEDECO PDE as the executive body. From the IT @ Baja, the CENI2T, Softtek-UABC onto the BIT Center, it has become evident that public resources of federal and state origin have been considerably important for the development of cluster initiatives.

Some notable differences are that the IT @ Baja comes from corporate will and there for all the efforts concentrated on financing, training and certification objectives, omitting the search for business networks through the establishment of new business and strengthening their relationship. The CENI2T emerges as academic initiative where the private sector was largely absent, although its focus was to build an initistive supported by corporate actors. The incubation of Softtek at the UABC allowed for, in 2013, the university campus to be successfully moved to its own premises in the industrial area of El Sauzal. For being the enterprise of a Mexican international corporate, which has had an impact on have job creation, rather than the generation of inter-relationships that strengthen cluster initiative.

While the IT @ Baja arises from a small group of businessmen with no business relationships in ICT, the CENI2T comes between academics without entrepreneurs while Softtek-UABC arises from a company in a university environment which offers networks and linkages that became mainly for recruitment. Having viewed all these initiatives before the BIT Center cluster, a constant government involvement as a local character with state and federal public resources can be observed, besides the presence of academic sector in a collaborative work that frames the triple helix. One can say only state that in the long run, this has gradually allowed the institutional construction of a cluster based on successes and failures seen in various early initiatives.

The BIT Center emerges as a strategy of the triple helix, with an organization led by a civil partnership, with a strong influence from the private sector through the CANIETI. It focuses on the promotion of service companies of ICTs, given that this sector shows the highest levels of productivity. Efforts to achieve the BIT Center are combined with a policy of support within the PEI contestable, in which the strong involvement of the ICTs services sector is evident. This shows the dynamism of the sector and the seeking of resources for its competitive development through innovation. The natural agglomeration being observed is a response to market demand and provides great potential for the ICTs sector to be developed in the context of the economic integration process in the Tijuana-San Diego border region, although, in the two versions of the PDE, the ICTs sector does not stand out as strong. However, according to Porter (Porter, 2000: 18), if not quantitatively but qualitatively it does highlight the sector itself, this might reflect its estimation problems, because the sector operates across the economy and it is complex to quantify their total profits.

The fact that the sector does not have a larger organization, is due to strong competition within, that gives it its dynamic nature, which is easier to perceive from a business perspective than from a statistical perspective. This level of competition is expressed in the same agglomeration that allows participants be aware of good or better practices through cooperation, both in their participation in PEI, and organizational skills that have to shape the BIT Center in both Tijuana and Ensenada.

It is interesting to highlight the continued participation in the promotion of the cluster by the state government through SEDECO and the positive learning capacity by the actors of the triple helix. The experience of building this cluster initiative in the last ten years can be leveraged to other industries or cluster initiatives that are in operation.

The BIT Center is a project that seeks to learn from the successes and mistakes that made previous efforts unviable, given that there has always been the support of the State Government, primarily, as a companion. The bottom line is that the results indicate that although having consensus there was no information that would predict the behavior of all actors to work together under a trust relationships. Results from the BIT Center experience must be

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awaited. A first impression is that the incentives of entrepreneurs that are installed in the BIT Center are well embroiled with the incentives of the cluster initiative and to a lesser extent ISSSTECALI incentives as a supplier of the property, because of its financial decline.

Consequently, although the BIT Center cluster initiative has traits of success in the region it is not without risk. These features are forming under a triple helix model, with measurable objectives under the methodology identified by [34]; which is promoted by both the private sector and the government, with 100% of initial funding provided by the government (state and federal funds), and partially self-financing operating expenses; that its members are minutes away and 86% of the industry is in a range of less than an hour; and it has a director promoter with great leadership, focused on attracting businesses.

These features would allow the cluster (BIT Center), to consolidate in the next two years if it achieves an occupancy rate of 75% of installed capacity or a flexible financing scheme with ISSSTECALI; which strengthens and identifies its capabilities; achieves a strong link with the IES; promotes collaborative work and integration of production chains between enterprises of the cluster and with others outside the ICTs sector; and promotes or increases the integration of ICTs as the strongest productive sector of the economy.

No doubt this experience contributes to the articulation of Regional Innovation System as is institutionally established in the Science, Technology and Innovation Act for Baja California [14]. Only the increase and strengthening of existing local capabilities will create an environment to manage new capabilities and increased competitiveness of regional development, which is reflected in increased welfare and economic growth through innovation.

REFERENCES

1. Asheim, B., & Gertler, M. (2003). "The geography of innovation – regional innovation systems". En J. Fagerberg, D. C. Mowery y R. R. Nelson (Eds.), **The Oxford handbook of innovation, Oxford University Press**.
2. Audretsch, D., Hülsbeck, M. & Lehmann, E. (2012), "Regional competitiveness, university spillovers, and entrepreneurial activity". **Small Bussines Economy**. Vol 39, núm 3, pp 587-601.
3. Bertoglio, O., & Johansen, O. (1982). **Introducción a la teoría general de sistemas**. Edi. Limusa.
4. Bhagwat, R. & Sharma, M. (2007). "Information system architecture: a framework for a cluster of small-and medium-sized enterprises (SMEs)". **Production Planning & Control**, 18(4), 283-296.
5. Boisier, S. (1994). "Universidad, desarrollo regional e inteligencia social". **Revista Latinoamericana de Estudios Urbanos Regionales (EURE).** Vol. 20. No 60. Santiago de Chile, Pontificia Universidad Católica de Chile.
6. Corrales, S. (2007). "Importancia del cluster en el desarrollo regional actual". **Frontera Norte.**Vol. 19. Enero-Junio 2007. pp. 173-201.
7. Clark, B. (1998). **Las universidades modernas: espacios de investigación y docencia**. Mexico: Miguel Angel/Coordination of Humanidades-UNAM. 411 págs.
8. Etzkowitz, H. (2003). "Innovation in Innovation: The Triple Helix of University-Industry-Government Relations". **Social Science Information**. 42 (3). 293-338. Obtained from: http://blogs.helsinki.fi/changingdynamics/files/2011/10/Eztkowitz-Innovation-in-Innovation.pdf
9. Fuentes, N., & Martínez P. (2003). "Identificación de clústers y fomento a la cooperación empresarial: el caso de Baja California". **Revista Momento Económico**, (125), pp. 39-57.
10. García, J. (2013). "Requieren impulsar el BIT Center". **Periodico Frontera**. Obtained from: http://www.fronteraensenada.info/EdicionEnLinea/Notas/Noticias/12112013/774963-Requieren-impulsar-el-Bit-Center.html
11. Hualde, A. & Díaz, C. (2010). "La industria de software en Baja California y Jalisco: dos experiencias contrastantes". **En: Estrategias empresariales en la economía Basada en el Conocimiento.** SIINCO 2010. Obtained from: http://www.concyteg.gob.mx/formulario/mt/mt2010/mt13/sesion3/mt133_ahualde_228.pdf
12. Hualde, A., & Gomis, R. (2006). "El cluster de software en Baja California: Dinámica institucional". **Trabajo y reestructuración: Los retos del nuevo siglo**. V Congreso nacional AMET.
13. Jacobs, J. (1969). **Economy of cities.** New York: Vintage.

ISSN 2304-0777 www.jitbm.com

14. LCyTIBC (2012). "Ley de Ciencia, Tecnología e Innovación para el Estado de Baja California". **Periodico oficial del Gobierno del Estado de Baja California**. Tomo CXIX, Num. 45. Obtained from: www.congresobc.gob.mx
15. Lindqvist, G. (2009). **Disentangling clusters: agglomeration and proximity effects**. Stockholm School of Economics. Ph.D. Tesis.
16. Lundvall, B., Johnson, B., Andersen, E., & Dalum, B. (2002). "National systems of production, innovation and competence building". **Research Policy**, 31, 213-231.
17. Martínez, E. (2008). "Clusters y sistemas productivos locales en la frontera norte de méxico: Baja California". **Pueblos y fronteras digital, Iniciativa empresarial y desarrollo local en América Latina,** , Vol.1, 2008, pp.25-35. Obtained from: http://www.pueblosyfronteras.unam.mx/a08n6/art_05.html
18. Marshall, A. (1920). **Principles of Economics.** 8th ed. Vol. Libro IV. London: Macmillan.
19. Minujín, G. (2005). **Competitividad y complejos productivos: teoría y lecciones de política**. Vol. 27. United Nations Publications.
20. Moctezuma, P., Maldonado, M., Zunini, L., & Ocegueda, M. (2012). "Diagnóstico para el mejoramiento en ciencia, tecnología e innovación: una evaluación de los fondos públicos en Baja California". En P. Moctezuma (coord). **Evaluación de los fondos públicos para el apoyo a la ciencia, tecnologia e innovación en Baja California**. GobBC - UABC. Pag. 9-70
21. Mungaray, A., & Palacio, J.(2000). "Schumpeter, la innovación y la política industrial". **Comercio Exterior.** Vol. 50. No.12. pp 1085-1089.
22. Mungaray, A., López, S. y Moctezuma, P. (2013). "La adicionalidad de los fondos públicos en la innovacion empresarial mexicana. El caso de Baja California, 2001-2010". **Revista de educacion superior.** Vol. XLII (3). No. 167. Julio-Septiembre 2013.
23. Navarro, M. (2001). **El análisis y la política de clusters**. Documentos de trabajo del Instituto de Análisis Industrial y Financiero. Documento de trabajo No. 27.
24. PECIT (2009). "Programa Especial de Ciencia e Innovación Tecnológica de Baja California 2009 – 2013". **Periodico Oficial del Gobierno del Estado de Baja California**. Tomo CXVI. Num. 34.
25. Otero, G., Lodola, A. y Menédez, L. (2004). **El rol de los gobiernos subnacionales en el fortalecimiento de Cluster productivos.** Ministerio de Economía, Gobierno de la Provincia de Buenos Aires, Argentina. Obtained from: http://www.ec.gba.gob.ar/areas/estudios_proyecciones/Archivos/Abril2004.pdf
26. Popescu, A. (2011) "The University as a Regional Development Catalyst: Frameworks to Assess the Contribution of Higher Education to Regional Development" **European Economic Recovery and Regional Structural Transformations**. Obtenido el 7 de febrero de 2014 en sitio: http://ssrn.com/abstract=1875874
27. Qian, H. (2010), "Talent, creativity and regional economic performance: the case of China". **The Annals of Regional Science**, vol 45, núm 1, pp 133-156.
28. Ramírez, B., Osuna, J. y Suástegui, B. (2012). "Vinculacion Universidad – Sociedad y el modelo de la Triple Hélice". **XIII Asamblea General de ALAFEC**. Asociación Latinoamericana de Facultades y Escuelas de Contaduria y Administración. Obtained from: http://132.248.164.227/alafec/docs/asambleas/xiii/ponencias/educacion/pdf/E_06.pdf
29. Ruiz, C.(2004). **Dimensión territorial del desarrollo económico de México.** Facultad de Economía. UNAM. México.
30. SEDECO (2012). **Memoria Documental BIT Center, Business Innovation and Technology Center de Baja California**. GobBC – Secretaria de Desarrollo Económico, Obtained from: http://www.economia.gob.mx/files/transparencia/informe_APF/delegaciones/bajacalifornia_btc.pdf
31. SEDECO (2010). **Hacia una Política de Desarrollo Empresarial de segunda generación en Baja California.** GobBC – Secretaria de Desarrollo Económico. Obtained from: http://www.bajacalifornia.gob.mx/sedeco/documentos/consulta/drAlejandroMungarayPDESG.pdf
32. SEDECO (2008). **Sistema de Investigación, Innovación y Desarrollo Tecnológico del Estado de Baja California**. GobBC – Secretaria de Desarrollo Económico. Obtained from:

ISSN 2304-0777 www.jitbm.com

http://www.bajacalifornia.gob.mx/sedeco/2008/sidebaja.html

33. Softtek (2012). **Nearshore Outsourcing**. Obtained from: http://www.softtek.com/es/approach/nearshore-outsourcing
34. Sölvell, Ö., Lindqvist, G., & Ketels, C. (2003). **The cluster initiative greenbook**. Stockholm: Ivory Tower.
35. UABC (2006). **Convenio de colaboracion UABC Softek.** Obtained from: http://www.ens.uabc.mx/fpv/Convenios/SOFTTEK/SOFTTEK_GENERAL.pdf