Cluster or No Cluster? Characterization Of Software Development Companies In Emerging Economies

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ABSTRACT

Software has become a ubiquitous element in modern societies and represents a high-value economic sector in the market. The objective of this work is to analyze its characterization, particularly in the region of Chihuahua, Mexico, by making a description and comparison of the situation of the companies oriented towards this sector, with respect to the cluster that already exists. This characterization allows establishing a diagnosis of the sector, which will help to define strategies aimed at strengthening such companies, as well as establishing comparative elements for companies of the same sector in other latitudes. The main findings point out that the companies surveyed as well as the cluster share the same problem and can work on solutions together.

Keywords: Software development; Development economies; México; Clusters.

INTRODUCTION

Software has become an omnipresent phenomenon in modern economies and is an indispensable input for a growing number of economic activities. Software is understood as the set of instructions stored in a computer-readable format that instructs them in how they should perform specific tasks [1]. By its nature, the software can offer a wide variety of functions, ranging from the most elementary management of the components of a computer orchestrated by an operating system, to complex applications that provide various functionalities for the end users [2]. Because of its malleability and its growing importance, the software industry requires professionals from all walks of life to interact and exchange knowledge. Software can be observed from different perspectives: that of the end users and what they need the software to do for them; that of software engineers and developers who translate user needs into computer programs; that of the managers who must orchestrate the

resources and the human material to operate the software; that of the industrialists who organize the companies that produce and distribute the software; that of policy experts and lawyers who must resolve conflicts inside and outside the industry without discouraging growth and innovation; and that of economists who must offer insights and views on how the software market works [3].

Although software has been produced for computers since the early 1950s, computer users and producers dominated their development until the late 1960s. Both computer users and producers play important roles in the production of current software, but the period since 1978 has witnessed the rapid growth of firms specializing in the production of commercial software [4]. These firms are known as Independent Software Vendors (ISV), because they are not linked either with the hardware manufacturers or with the end users. For developed economies, software is important from two angles: as an economically important industrial sector (vertical) and as an innovation enabler in other industrial sectors (horizontal). It is for this reason that the expected economic impact of software innovation is possibly greater when its impact is observed throughout the economy and not when only the capital invested in the sector is examined [2]. This paper describes the characteristics of seven companies that are dedicated to software development for commercialization in the city of Chihuahua and compare them to the evaluation of the cluster of Information Technology (IT) that already exists in the entity, in order to be able to establish a diagnosis that allows the creation of strategies that will foster development and strengthen all of them.

SOFTWARE INDUSTRY

The software industry consists of the global application software, systems software, and home entertainment software markets. Application and system software segments are categorized into B2B (business to business) and end-user applications that include mobile applications and desktop applications. The IT services industry is comprised of global data processing and outsourcing markets, as well as the global IT consulting market and other services. The global data-processing and outsourcing market includes electronic data-processing service providers and business process outsourcing (BPO) services. The IT consulting services market includes information technology service providers and system integration services. Finally, the global internet services and software market consists of companies that develop and sell Internet software or provide Internet services including databases accessed through the Internet and interactive services, web address registration services, databases, and website design services. The global software and services industry has fluctuated in growth over the period form 2008 to 20012. However, its growth is expected to stabilize in the following years and until 2017. In 2012 sales of this industry amounted to 2.596 billion dollars, representing an annual growth of 4.8% in the span from 2008 to 2012 [5], [6].

Software industry in Mexico

The domestic market for the software and services industry in Mexico grew 11.9% in 2012 reaching a value of 8.83 billion US dollars, representing 1.4% of the American market. The Mexican software market is divided into the following segments: Software for network and database management that represents 24.3%; general productivity applications for business and home that represents 23.6%; vertical applications for industry 21.2%; software operating system 18.2%; other system software 8.6%; other application software 4.2%. In 2012 Mexico became the third exporter of IT services worldwide, after India and the Philippines [7].

Opportunities for Chihuahua in the software industry

The software industry can flourish in Chihuahua because this state has been characterized as a human capital exporting entity with computer training, which is the main input of this

industry. Many professionals and computer technicians have left the organization and work successfully in the national software industry and in many cases in other countries in global companies, occupying important positions. In addition to the availability of human capital, Chihuahua's geographical location puts it near the main market for the software industry, there is also greater compatibility with North American culture compared to other industry competitors such as India, by sharing the same time zones, and having acquired extensive experience with the North American corporate culture with the establishment of Mexican manufacturing companies in the country since the 1960s. All this has contributed into giving Chihuahua a good opportunity to become a competitive region in this industry.

CHIHUAHUA IT CLUSTER (CITC)

For the purpose of this exercise, clusters are considered as business networks and research institutions (including universities) that have a thematic focus, are regionally concentrated, and are organized in an institution managed by a cluster administrator or a team of Cluster management. The cluster may also include other actors such as public bodies. The management organization of the Cluster is a management office that coordinates the activities of the participants within it. The Cluster management organization is led by participants and is in charge of representing them, both internally and externally, as well designing and implementing activities that support their development [8].

"Chihuahua IT Cluster" (CITC) is the name of the only cluster of information technologies formed in the city of Chihuahua in March 2011, and whose objectives and characteristics are described below, according to the evaluations requested by the Ministry of Economy [9], [10], as well as a report from the European Observatory [8] and whose reports and data are used as reference here:

Vision, objectives and activities of the CITC

The vision of the cluster is framed as: "Being the main IT service providers, with different specialties and certified personnel in the different processes of the value chain in the industry, which allows for the generation of worldwide solutions." The main objective of this business center is: "To be an association of private companies, academic institutions, research centers and dependencies of the Municipal, State, and Federal Government, with the purpose of promoting the development of the IT industry, thus generating solutions of Value for the Industry ", considering innovation as the main premise. Among the most important strategies that this entity intends to execute so far, there are: increasing value added, developing value chains, and improving the business environment. In second instance: attract more companies and investments, encourage innovations, increase employment, reduce production costs, increase exports, and seek funds.

To achieve these objectives, the planning of actions is necessary and for the CITC, there are a series of clearly defined and delimited activities. The most important is the promotion of its services, due to the phase in which it is: growth. The next activity mentioned, in order to achieve objectives, is the improvement that can be obtained in educational programs, with the support of the education system; this in order to achieve congruence with the needs of the cluster. In addition, it is important to raise student enrollment in IT areas.

The formula, cluster = private initiative + government + education, is paramount for the proper functioning of a cluster. It is for this reason that the activities to be carried out are focused in achieving greater interest in these three sectors. It is noteworthy that the activity is intended to promote changes in both political and government regulations, because there are no well defined IT cluster regulations for the entity. However, it is not a relevant activity at the

moment, since the work in other areas is more significant, in order to achieve the impetus that is required and be among the best in the country.

Composition and financing

Up to date, the Chihuahua IT Cluster has nine affiliated companies and registers a turnover in 2012 of 16.27 million dollars. In addition to companies that are part of the private sector, there is participation of educational institutions, among which are Monterrey Institute of Technology and Higher Studies (ITESM, in Spanish), Technological Institute of Chihuahua (ITCh, in Spanish) and Chihuahua State University (UACh), as well as agencies of the three levels of government: municipal, state and federal. Most of these companies are made up of national capital (78%). The financial support received by the CITC comes mainly from PROSOFT by 52%, followed by support from CONACYT and bank loans with 30%, the rest are internal sources and others. The most important factor in the economy of the city and the state of Chihuahua, is the maquiladora industry. There are several industrial parks part of this sector, in contrast to just two technology parks that house companies dedicated to offer IT services, called "technoparks". One of them is the "Innovation and Technology Transfer Park" (PIT2), belonging to ITESM and the other is the UACh "Tecnoparque". The first one mentioned is more organized and articulated, while the UACh one is in a structuring process. Both technology parks integrate "Chihuahua IT Cluster".

Human talent

In the CITC the functions performed by employees are basically broken down into the following: services focused on information technologies, management, support to various activities, operational, administrative, various functions, sales and marketing. The order in which these functions are mentioned is derived by the percentage of employees involved in each of them. This means that the highest percentage of employees perform functions focused on Information and Communication Technology services (55%), followed by the roles of managers as well as support staff, while the percentage of employees dedicated to sales and marketing is lower (5%). This reflects the cluster's priorities, now looking for a solid positioning in the market, which is why they require strategies for management levels. The majority of the CITC employees are graduates of national universities (29%), state and local educational institutions (27%), technical schools (24%) and universities abroad (20%). There is a very clear balance between the main sources of human capital trained to carry out the work of the CITC. One of the main difficulties faced by professionals graduating from state and local institutions to be part of the companies that make up the cluster is the certification on read and spoken English language; 62% of the workforce has this certification, but the rest is not certified.

CLUSTERS EVALUATION METHODS

There are several investigations of global use for cluster analysis. In the first one, the Meta-Study of Michael Porter and Claas van der Linde, the factors that determine competitiveness in Porter's diamond [11] are analyzed. The findings from the Cluster Meta-Study are then studied for strategy and competitiveness through the Harvard Business School. On the other hand, a second great reference comes from the report Cluster Initiatives in Developing and Transition Economies of the Center for Strategy and Competitiveness [12], in which the performance of the Clusters was analyzed according to the type of initiative by which they were created, considering for this: Type of initiator, Objectives, Activities, Sources of financing and some quantitative variables as number of companies that make up the Competitiveness Index (CI), the size of the companies measured by the number of workers or by the number of companies that comprise it.

According to the model of the European Observatory of Clusters, the following groups of factors are recommended to measure the quantity and quality of knowledge that circulates and extends between the companies located in a cluster:

A. Size: number of companies, employment, turnover and added value, among other economic data.

B. Specialization: proportion of the economic data in a category (types of business, proportion of software and services in billing, proportion of employees of software and services, proportion of employees with certification, among others).

C. Focus: proportion of employees and other economic data with respect to the total of a region.

These three factors: size, specialization, and focus, help to know if the cluster has reached a "specialized critical mass" to develop positive side effects and long-term links. According to this observatory, it is preferable to use data on wage mass, productivity or value added, if available, instead of employment, although this tilts the balance in favor of knowledge clusters.

MATERIALS AND METHODS

The present investigation was mainly descriptive, with support of the relevant and available literacy review up to 2014. In addition, seven software development companies, located in Chihuahua, were surveyed, with information provided by their owners or employees, according to the willingness to respond the instrument applied. The instrument applied for gathering the information was elaborated and provided by Dr. A. Hualde and Dr. R. Gomis from the Northern Border College. It consists of more then 50 items, but not all of them are used in this comparison, only the ones considered associated with the indicators established according to the model from the European Observatory of Clusters. Since this was the one used by the previous analysis in order to be able to compare data obtained from survey and information from the Chihuahua IT cluster.

RESULTS

A series of comparative tables with the results obtained from this research, regarding Size, Specialization and Focus dimensions are showed:

Size

Table 1. Size dimension.

Indicator	Surveyed companies	CITC
Quantity	7	9
Employees	99	322
Sales	43% between 1-5 millions of MXP 57% No data available	Total 16.27 millions of USD
Capital funding	71% national 29% foreign	78% foreign

Adapted from [8], [9], [10]

Specialization

Table 2. Specialization dimension.

Indicator	Surveyed companies	CITC
Products and services	100% Application software (COTS) and custom software (videogames, electronic billing, quality systems, logístic, e-commerce). Most of them non registered as patents. 57% Trainning services 42% Consulting services	More than 50% software 43% IT services 5% hardware
Exportations	28% expors 29% no exports 43% Not know Countries: India, Brazil, Russia, Colombia, El Salvador and E.E.U.U.	More than 60% exports
Sectors they serve	85% private sector, SMEs (nationals and foreign) 14% state government	34% private sector, SMEs 21% municipal government 20% state government
Human Talent: Skills and specializations Activities developed Employees'studies	Available skills: 27% software development 23% technical specializatin 19% foreign language (English)	Large companies show task specialization and a balanced work structure. Smaller ones show no specialization or balance 62% English language certification ----------------- 55% ICT 5% sales and marketing ------------------ 29% National universities 27% State/local universities 24% technical studies 20% Foreign universities

Quality Certifications	43% Yes. From this:
	    86% national certifications (Moprosoft, simplified version from CMMi)
	    14% international certifications (Microsoft Partner)
	28% No
	29% Not know
		50% Moprosoft
		17% CMMi
		33% Others

Adapted from [8], [9], [10]

Focus

Table 3. Focus dimension.

Indicator	Surveyed companies	CITC
Relevance of ICT sector in region	Focus towards SMEs and public sector, less oriented to manufacturing No relation/vinculation between companies with other sectors, like education or manufacturing.	Relative weight of cluster companies is small compared to other sectors such as advanced manufacturing, government and SMEs in industry and commerce, Oriented to public sector and SMEs, little orientation to manufacturing. Little synergy of Research + Developement + innovation centers with cluster companies. Challenges in capital availability and financing.
Competitiveness of the state / region		Mexican Institute of Competitiveness grants the state of Chihuahua the 16th place among the 32 states of the Mexican Republic. 1st. place in use of International relations

Adapted from [8], [9], [10], [13]

CONCLUSION

As can be seen in the results obtained from the companies surveyed and those belonging to the cluster, the characterization of both groups shows similarities that allow to recognize common ground regarding problems, and therefore allowing to look for solutions together. It must be recognized that the cluster is currently in the process of maturity, analyzing opportunities and developing strategies to place itself in the ranking of the best in the country and thus position itself at the forefront of global competitiveness. Therefore, although the primary objective of any economic entity is to increase its productivity to translate into greater economic income, competitiveness, among other equally relevant aspects, take the forefront in the case of the CITC (Chihuahua IT Cluster). The same is true for the companies surveyed, however due to the stage of expansion and solidification in the market that they all go through, these objectives pass to a second instance.

Regarding the Size of software development companies and those belonging to the cluster, they show similarities in their composition and orientation. Most are made up of national capital, which puts them at a disadvantage compared to the more competitive clusters in the national territory, whose foreign investment is greater. In cases where their capital is of foreign origin, this also allows them to export their products without major problem to their place of origin. It is clear that there is no sense of partnership between the different software development companies in the locality, which does not allow them to take advantage of the potential available benefits of creating synergy between them. Although some of the companies belong to the cluster, they do not recognize this association as an element that gives them a competitive advantage. They give more value to the geographical location, cost and quality of labor. The managerial capacity, reflected in the decision making at that level of the organization in the companies, depends to a large extent on the managerial practices that make

the difference between the most competitive organizations: innovation, human resources, IT capacities, collaboration, among Others. The adoption of the best practices in this area, are areas of high value added opportunity. This is reflected in the priority assigned to the objectives, where management-oriented ones predominate, while those related to innovation are left out, when these are the ones that should guide companies in the sector. Also, there is imbalance in the development of activities among smaller companies, where there is no management team supported by a group of specialists / technical developers, which translates into higher operating costs for these small organizations.

In relation to the Specialization, they show a clear orientation towards the development of software and services to sectors of private initiative, particularly SMEs, and followed by the public sector, but leaving aside the manufacturing sector, which is the predominant in the region. It is interesting to note that only half of these products are registered, which is a vulnerable point for all these companies. It is necessary to increase the link with educational institutions, in order to increase the capacity of both teachers and students, in order to incubate knowledge companies. It's important to look for young people capable of working in teams, and teachers who generate knowledge, whose experience can lead to the creation of companies with processes of innovation and development. There is a need for greater focus on technology specialization in schools in the region. Since it is a reality that most of the professional staff that make up the cluster, are graduates of institutions outside the entity (49%). Not surprisingly, the lack of local talent to employ, coupled with disengagement with the education and research sector, reflected in the lack of skills required, adds to a lack employee training, either due to lack of resources and/or time. It is not surprising that most of the funds obtained are used in this training. Although most companies lack international certifications in order to expand to international markets, for some of them, this has not been an obstacle for seeking markets in Central and South America. This situation could also be explained by the lack of command of the English language among the members of the local software development companies.

As for the Approach, the city is generally seen as a low-cost manufacturing center. Currently, the IT sector in Chihuahua does not function as an element of process linkage or development. It is for this reason, that there is interest in promoting the services of these companies, which would allow them to generate chains of value between them and their clients-market. Although the IMCO gives the state of Chihuahua the 16th place among the 32 states of the country, there is little synergy with the local economy, reflected in sales in the region. There are barriers in the environment that hinder its growth, such as specific problems associated with human talent and capital [14], [15], [16]. During the last state administration (2010-2016), there was a total lack of state government support for the PROSOFT fund

Sadly, it is established that the Chihuahua IT cluster has not achieved its objectives, since their associates present the same problematic as companies that do not belong to the association.

As recommendations, it is necessary for the survival of this sector to establish strong linkage between them and also with other sectors, like manufacturing and education. Since IT, and particularly software development is a transversal "commodity", there are plenty of opportunities, mainly related to the manufacturing sector, the strongest one in the region. This will help the strengthening of organizational capacity through the promotion of joint innovations that will allow these companies to be linked to their final market.

It is then that it makes sense to design a cluster structure, with the linking of all the entities mentioned: public, private and educational. The cluster seeks to generate knowledge, innovate,

develop, and efficiently value chains through its internal components. This would generate a more effective participation between software companies, ICT services, multimedia, and research centers, through comparative services and training. With this, the intention is to meet and support the needs of the local companies involved in advanced manufacturing, domestic and international market. Therefore, it is essential to prioritize the promotion of the services offered by all these companies, so that they seek to create synergies that favor them. In addition, they should seek the interest of other sectors of the economy in the State of Chihuahua, particularly in the case of the export manufacturing industry, an important sector for the regional economy, and one that requires mostly these services in relation to technology, particularly in terms of software development.

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