

Business processes of the software industry in the city of San Francisco de Campeche

Procesos empresariales de la industria de software de la ciudad de San Francisco de Campeche

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Abstract

In Mexico, micro, small and medium-sized enterprises (MSMEs) are the backbone of the economy because they generate approximately 52% of the gross domestic product and 72% of direct employment (INEGI, 2019). For their part, MSMEs developing software, both in industrialized countries and in less developed countries, face global competitiveness, so the role of the State and its ability to direct the economy represents a determining factor in the promotion of this industry. This research presents the results of a diagnosis of the characteristics in which the software industry operates in the city of San Francisco de Campeche, capital of the state of Campeche. The results allow identifying the most relevant characteristics of this industry in order to examine the areas of opportunity to increase its productivity and economic growth, which translates into benefits for the society of Campeche.

Software industry, Clusters, MSMEs software, Technology, Development

Resumen

En México, las micro, pequeñas y medianas empresas (MiPymes), son la columna vertebral de la economía debido a que genera aproximadamente el 52 % del producto interno bruto, y el 72 % del empleo directo (INEGI, 2019) Por su parte, las MiPymes desarrolladoras de software, tanto en países industrializados como en los de menor grado de desarrollo, se enfrentan a una competitividad mundial, por lo que el papel del Estado y su capacidad de direccionar la economía representa un factor determinante en el impulso de esta industria. Esta investigación presenta los resultados de un diagnóstico sobre las características en las que opera la industria de software en la ciudad de San Francisco de Campeche, capital del estado de Campeche. Los resultados permiten identificar las características más relevantes de esta industria para examinar las áreas de oportunidad con el fin de elevar su productividad y crecimiento económico, lo que se traduce en beneficio para la sociedad campechana.

Industria de software, Clústeres, MiPymes software, Tecnología, Desarrollo

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Introduction

Micro, small and medium-sized enterprises (MSMEs) represent the segment of the economy that provides the largest number of economic units and employed personnel worldwide; hence the relevance of this type of enterprise and the need to strengthen their performance, as they have a fundamental impact on the overall behaviour of national economies (Bastos et al., 2009) (Biolchini et al., 2005).

MSMEs make up the majority of the workforce in the world, accounting for more than 80% of the companies in the countries, their main characteristics are: having limited human resources and capital, not having an implemented development standard, committing to any type of work that is presented to them, noting the lack of specialisation in a specific niche and generating unrealistic estimates in time and resources (Ortiz and Arredondo, 2014). (Ortiz and Arredondo, 2014).

The criteria for classifying micro, small and medium-sized enterprises are different in each country; traditionally, the number of workers has been used as a criterion for stratifying establishments by size, and as complementary criteria, total annual sales, income and fixed assets.

According to data from the 2009 economic census of the National Institute of Statistics, Geography and Informatics, in Mexico MSMEs have become the backbone of the economy because they generate approximately 52 % of gross domestic product and 72 % of direct employment (INEGI, 2010). However, they subsist in the midst of an aggressive, demanding market, with insufficient access to update their technology, complex administrative procedures, few facilities to obtain credit, so that it could be thought that it is only the government's responsibility to promote them, however it should be a joint effort, to conceptualise in a different way that favours an integral productive apparatus in which, among other factors, long-term sustainable business models are preserved, with job creation or maintenance, increasing own capital savings that favours their growth. (Hernández, 2009).

MSMEs in the software industry are not exempt from these problems, facing global competition, which is why the state and its ability to direct the economy takes on a preponderant role (Wadee, 1999). It is important to investigate the way in which micro, small and medium-sized software development companies survive as economic units, and to identify the reasons that prevent them from growing organisationally and economically, as they are part of the economic engine of countries. In Latin America, several studies have been carried out to improve the software industry, taking as a reference the factors that have influenced the high competitiveness of this sector in countries such as South Korea, Taiwan and Singapore, among others of the so-called Asian tigers (Jenkins, 2007).

A growth factor for software development companies is their membership in a cluster, which according to Michael Porter, is defined as: "Geographic concentrations of interconnected firms, specialised suppliers, service providers, industrial firms, related industries, training institutions, and support organisations linked to technologies or end products within a local area or region" (Porter, 1998). Within the cluster, regardless of structure, size and sector, a number of basic concepts can be identified that develop its nature:

Community: firms operate in common fields or related industries with a shared market focus or sphere of activity.

Concentration: a cluster of firms can and do interact in a more direct and fluid way.

Connectedness: firms strengthen different types of relationships with each other (Salinas and Montes, 2016).

The initial activities of a cluster are in the universities, because the professionals who have graduated from these universities will be the employees of the companies, and there is even the phenomenon of having worked for the same companies before and, therefore, they are concentrated in a geographical area (López and Ramon, 2009).

One of the characteristics of the cluster is that common professionals come together spontaneously to exchange experiences and ideas, something that rarely happens in global relationships. This is where the true value of a business cluster lies (Orozco and Garcia, 2003).

Cluster initiatives should seek to generate favourable ecosystems for innovation, where multidisciplinary actions involving various actors and sectors are carried out. This paper presents the internal organisation of software development companies in the city of San Francisco de Campeche, capital of the State of Campeche. It presents data on how they have organised themselves externally through a cluster, and also those who have decided to work separately,

Methodology

The methodology for this work begins with the creation of an instrument that will help to measure the software industry in the city of San Francisco de Campeche, divided into three stages:

Instrument design

The systematic review methodology was used, which was developed in order to compile and evaluate the available evidence pertaining to a topic.

Protocol development

a) Question formulation

1) Question focus:

To identify the set of indicators to create an instrument to assess the software industry in the city of San Francisco de Campeche.

2) Breadth and quality of the question.

a) Problem:

Currently there are no recent studies that indicate or detail the condition in which the software industry is in San Francisco de Campeche, that is why it is of utmost importance to propose a set of indicators that help to create an instrument to be able to measure the performance of the software industry.

b) Question:

What are the most relevant indicators to evaluate the software industry in the city of San Francisco de Campeche?

Is it possible to classify the indicators that allow to evaluate the software industry of the city of San Francisco de Campeche?

c) Keywords and synonyms:

The definitions used to solve the research question were: software, software industry, technology, growth, boom, economy, investments, ICT, software clusters, 2004, 2005, 2007, 2008, 2009, 2012, 2014, 2018.

d) Intervention:

Indicators to assess the software industry in the city of San Francisco de Campeche.

e) Outcome:

Studies to identify strengths, weaknesses, opportunities and threats of the software industry sector in the city of San Francisco de Campeche.

f) Field of research:

Publications related to the quality area of the software industry from countries around the world.

Construction of the instrument: indicators

The process and results of the systematic literature review are presented in the article "Propuesta de indicadores para evaluar la industria de software de una región", by Mex Álvarez, Manzanilla Yeh, Hernández Cruz, Cab Chan and Ortiz Cuevas where 42 specific, observable and measurable indicators were obtained that can be used to show the changes and progress that the software industry is making and that were classified into seven categories.

The proposed categories are: organisation, human resources, financial situation, infrastructure, research, innovation, development and technology, products and services, markets, business processes, and marketing and communication.

With the generation of these indicators, studies can be carried out to identify the strengths, weaknesses, opportunities and threats of a software industry sector (Mex Alvarez et al., 2021).

In this work, two of the seven categories are presented, which are research, innovation and technological development, as well as business processes, in which 16 indicators were established for the first category and 63 for the second. In order to collect the indicators with the least possible number of questions in a synthesised manner, questions were designed that encompass several indicators (Romero and Camio, 2010) [15], distributed as shown in figure 1.

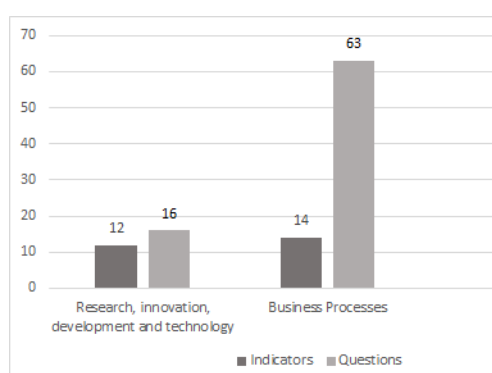


Figure 1 Indicators and questions by category

Source: Own elaboration

Application of the instrument

In order to collect the participations of the companies invited to the research project, the administrator of the platform called: Virtual Observer, should register them with their name, contact telephone number and e-mail address. Figure 2 shows the registration window.

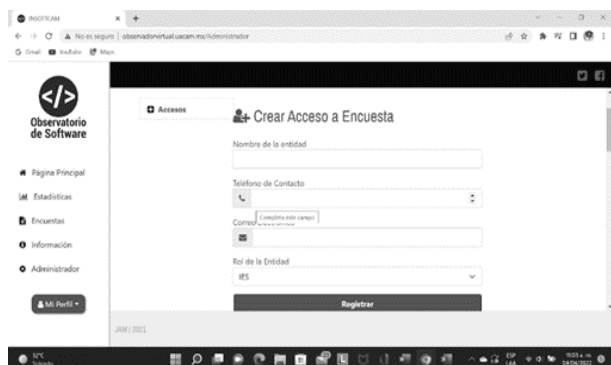


Figure 2 Registration window

Source: Own elaboration

Once the entity is registered, a token is generated that will be active until the survey is completed. Figure 3 shows the window where tokens are administered.

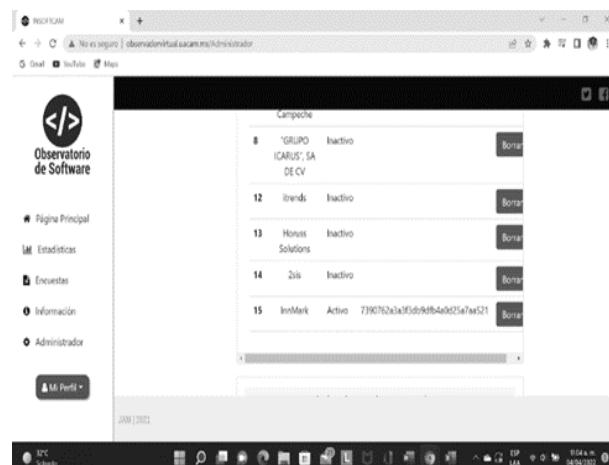


Figure 3 Administration of tokens

Source: Own elaboration

Registered companies can answer the questionnaire by entering the URL: <http://observadorvirtual.uacam.mx/Encuestas>.

They must then enter the token, which was previously sent by e-mail. Figure 4 shows the login window.

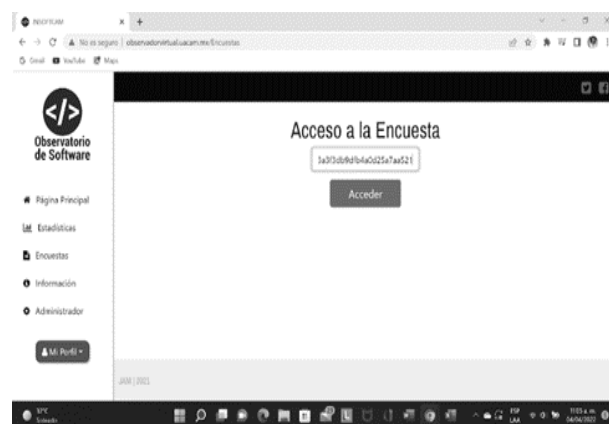


Figure 4 Access window

Source: Own elaboration

Once the token has been validated, they can start filling in the corresponding answers, as shown in figure 5.

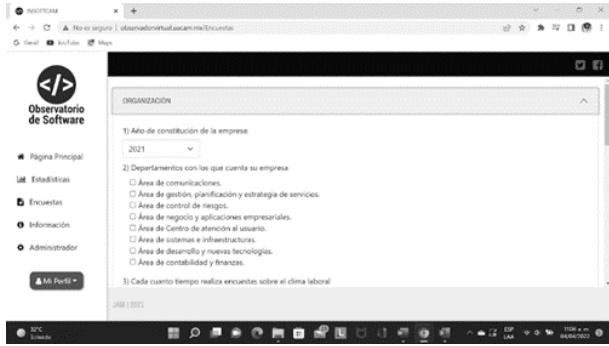


Figure 5 Survey capture form
Source: own elaboration

Target population

According to data extracted from INEGI, during the 2020 population census, the state of Campeche consists of approximately 928,363 inhabitants, of which 294,077 are located in the capital city called San Francisco de Campeche (Campeche Innovation Agenda, 2015) The municipality of Campeche is the first in order of demographic importance of the eleven that make up the state. Its municipal capital is the city of San Francisco de Campeche, capital of the state and main urban centre, covering a territorial extension of 3,410.64 km², which represents 5.99 % of the total area of the state and its population density is 91.2 inhabitants/km².

From an economic point of view, the state of Campeche is among the richest in the South-Southeast region, due to its oil activity (Campeche Innovation Agenda, 2015). Another characteristic of the state is the promotion of sustainability, being one of the most competitive entities in monitoring air quality and having the highest volume of wastewater treated.

The software industry in the State of Campeche began in the 1990s with an SME made up of entrepreneurial industrial engineers and computer science graduates, about which there is little information, since it lasted only a few years in operation. The average age of operating software development MSMEs in Campeche is 10.5 years.

In 2010, the Information Technology Industry Council of Campeche (CITI Campeche) was created, becoming the first technology cluster in the state. CITI Campeche began with the mission of contributing to the development of the IT industry, promoting the various companies that formed it, as well as the creation of new companies that respond to the needs of the national and international market, all through strategic alliances. Unfortunately, the Campeche cluster did not manage to transcend and a few years later it was closed. In 2019, a new cluster of information and communication technologies was created in Campeche, born from an alliance between professional companies in the ICT sector, government, universities and leaders in the state of Campeche, called Ah Kim Tech.

The companies that make up this cluster are listed in Table I according to their line of business, i.e., by the type of productive and economic activities that the companies have.

PYMES	Turn
Pyme 1	Software development, related services and marketing
Pyme 2	Design and related services
Pyme 3	IT security
Pyme 4	UAV implementation
Pyme 5	Marketing company
Pyme 6	Industrial projects and civil works
Pyme 7	Software development and marketing
Pyme 8	Design and related services
Pyme 9	Other
Pyme 10	Software development, commercialisation, networking, marketing
Pyme 11	Industrial projects and civil works
Pyme 12	Other

Table 1 Ah Kim Tech cluster companies
Source: Own elaboration

Of the 12 companies that make up this cluster, only three are dedicated to software development. It is worth noting that most of the companies that make up the cluster in the city of San Francisco de Campeche include more than one line of business in their companies, as is the case of SME 10, SME 7 and SME 1, which, despite being software developers, also handle marketing, commercialisation and network management. The business lines of the cluster companies can be seen in figure 6.

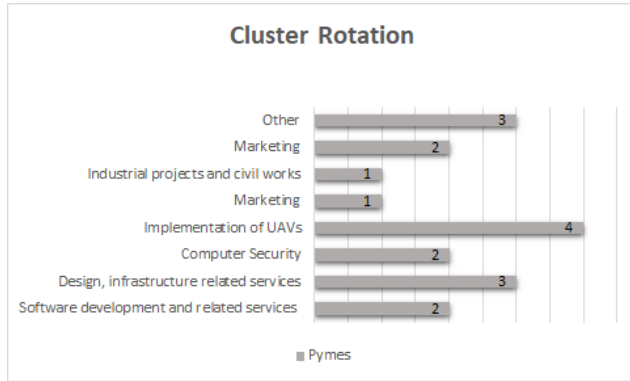


Figure 6 Business lines of the companies in the cluster
Source: Own elaboration

The target population of the instrument is made up of all the software development companies that have their fiscal domicile in the city of San Francisco de Campeche, a total of six, of which three belong to the Ah Kim Tech cluster and three do not belong to any association.

On the other hand, there are three development companies that are not affiliated to any association or cluster. These are listed in table II.

PYMES	Turn
Pyme 13	Software developer and marketing.
Pyme 14	Software developer, network administration and training.
Pyme 15	Software developer and marketing.

Table 2 Non-affiliated software development companies
Source: Own elaboration

Like the companies affiliated to the cluster, the non-affiliated companies also cover more than one line of business. Figure 7 shows the lines of business of the non-affiliated companies.

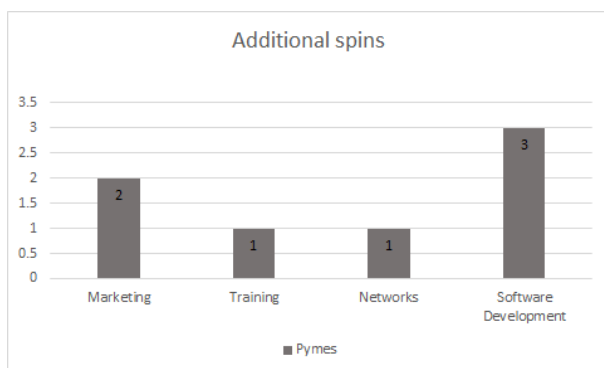


Figure 7 Turnover of non-affiliated companies
Source: Own elaboration

The application of this instrument was carried out during the month of March 2022, a total of five development companies participated, two from the Ah Kim Tech cluster (since one of the three, for health reasons the manager was unable to answer the survey) and three that are not affiliated, as shown in Figure 8.



Figure 8 SME participation
Source: Own elaboration

Results

The software developed, called "Virtual Observatory", automatically performs the statistical analysis of the data thanks to the definitions of variables and formulas that were established in the construction of the instrument, therefore, it offers the option of visualising the results from different perspectives.

Figure 9 shows the innovation activities, it can be seen that none of the companies consider the activity of satisfying future needs as a priority, since they are based more on sustaining existing market needs, as well as responding to accidental activities and unexpected opportunities that may be created by competitors (Riva, 2005).

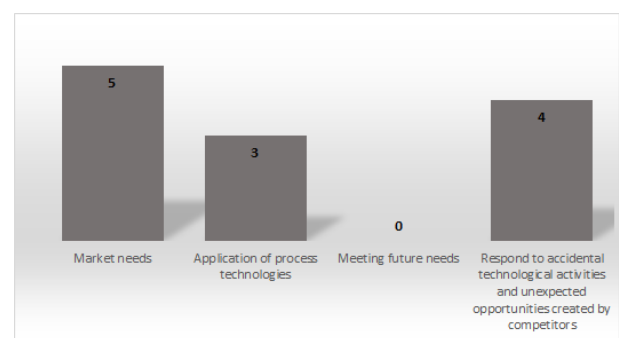


Figure 9 Number of MSMEs by innovation activities
Source: Own elaboration

Figure 10 shows the activities related to research, innovation and development that SMEs prefer not to carry out. This graph shows that one company is in the National Register of Scientific and Technological Institutions and Companies (RENIECYT).

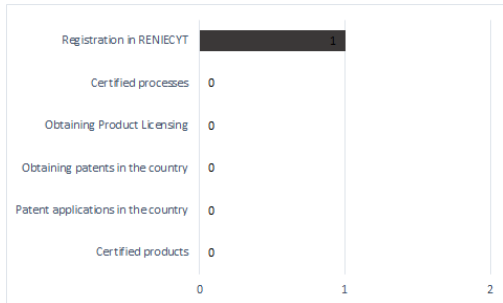


Figure 10 Number of MSMEs by research, innovation and development activities
Source: Own elaboration

Figure 11 shows some certifications that contribute to the improvement of MSMEs' business processes; however, in the survey, none of the MSMEs registered having any of them.

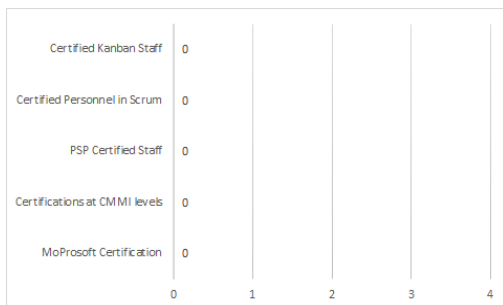


Figure 11 Number of MSMEs with certifications
Source: Own elaboration

Regarding measurement and control processes for quantitative process management, Figure 12 shows that a company carries out the activity of inspecting organisational process performance, which helps companies identify gaps in performance against business objectives and implement improvements to close the gaps (Garcia, 2013).

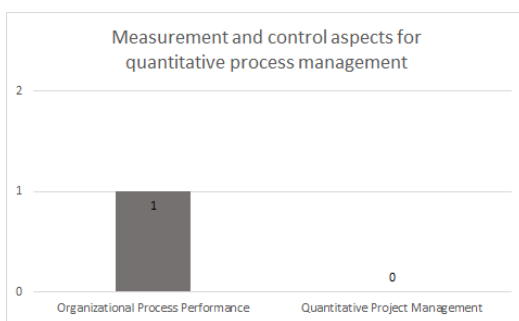


Figure 12 Number of MSMEs that use measurement and control aspects for quantitative process management
Source: Own elaboration

Figure 13 shows the number of MSMEs that carry out various activities to standardise their processes; among the most used are: validation, verification, product integration, technical solution and requirements development.

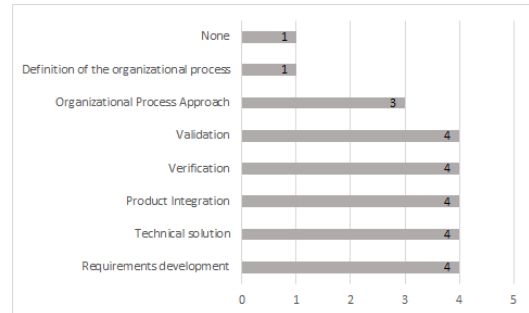


Figure 13 Number of MSMEs considering aspects for the standardisation of their processes
Source: Own elaboration

The results showed that three of the MSMEs do not use any of the basic aspects for the management of their projects, two of the participating companies consider that the most important aspects are project planning, as well as requirements management. Regarding process and product quality assurance, supplier agreement management and the monitoring and control programme are implemented by at least one of the companies, as shown in figure 14.

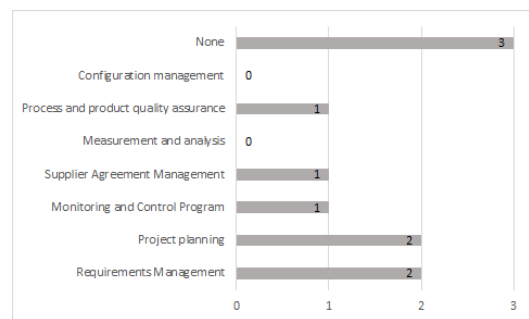


Figure 14 Number of MSMEs using basic aspects of project management
Source: Own elaboration

Conclusions

Thanks to the application of the instrument and the approach to development companies, it is possible to have an overview of the internal conditions involved in the economic development of the software industry in the city of San Francisco de Campeche, as well as to identify its composition and technical capabilities.

The software industry in Campeche is symmetrically segmented between companies that are committed to working collaboratively in a formal organisation such as a cluster and those that have managed to succeed without being part of a collaborative network. For future research, a comparative study of the strengths and weaknesses that characterise these two sectors can be undertaken (Jenkins, 2007).

We observe a software industry reactive to market needs, to improve processes or to respond to accidental technological activities and unexpected opportunities created by competitors, which has not yet come up with products to meet future needs. It would be useful to investigate the reasons why visualising new services has remained limited (Ortiz and Arredondo, 2014).

Most of the SMEs studied value the standardisation of their processes through validation, verification, product integration, technical solution and requirements development, however, to date none is certified or in the process of certification by any recognised standard, although one of them states that it has obtained certification by the Technical Standard NMX-059/01-NYCE-2005 of the MoProSoft software industry process model at level 2, thanks to the government programme Mexico Firts (Vera, 2019). It remains to be seen why companies have not opted for certification of their processes and personnel. On the other hand, project management is an activity that half of the companies do not carry out formally, which reinforces the importance of encouraging interest in raising the standards of internal processes (Merchán, 2007).

To conclude, we leave the reflection taken from the United Nations Conference on Trade and Development (Secretariat, 2001) to consider the software industry as a priority sector for the generation of new jobs and industrial growth based on the creation of software supply for export.

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