Paakat
Revista de tecnología y sociedad

Public policy for the appropriation of ICT in organizations in Mexico: the case of Prosoft

Política pública para la apropiación de las TIC en organizaciones en México: el caso del Prosoft

http://dx.doi.org/10.32870/Pk.a11n20.577

Raúl Arturo Alvarado López*
https://orcid.org/0000-0002-2990-7963
Universidad Autónoma de Querétaro

Received: October 20, 2020
Accepted: February 15, 2021

ABSTRACT

The objective of the article is to analyze the impulse to the appropriation of Information and Communication Technologies (ICT) at the organization level through the application of the public policy called Program for the Development of the Software Industry and Innovation (Prosoft, by its acronym in Spanish), created in Mexico since 2004. The methodology is an exploratory-descriptive analysis supported by secondary information, based on some available results of the program and the certifications of the beneficiaries, in addition to basing it on a theoretical-conceptual framework on the economy of innovation. The results indicate that Prosoft, as a public policy, has managed to promote innovation activities in the ICT sector in Mexico, which has favored the processes of technological appropriation in both the public and private sectors, which is based on learning activities and construction of technological capabilities.

Keywords
Technological appropriation; Learning and technological capabilities; ICT

RESUMEN

El objetivo del artículo es analizar el impulso a la apropiación de las tecnologías de la información y comunicación (TIC) a nivel de la organización mediante la aplicación de la política pública denominada Programa para el Desarrollo de la Industria de Software y la Innovación (Prosoft), creado en México en 2004. La metodología es un análisis exploratorio-descriptivo con el apoyo de información secundaria sobre algunos resultados disponibles del programa y las certificaciones de los beneficiarios, y se fundamenta en un marco teórico-conceptual sobre la economía de la innovación. Los resultados indican que el Prosoft, como política pública, ha logrado impulsar actividades de innovación en el sector de las TIC en México, lo que ha favorecido los procesos de apropiación tecnológica tanto en el ámbito público como en el privado, lo cual se refleja en actividades de aprendizaje y construcción de capacidades tecnológicas.

Palabras clave
Apropiación tecnológica; aprendizaje y capacidades tecnológicas; TIC

* PhD in Economics from UNAM, in the area of Economics of Technology. Research professor at the Universidad Autónoma de Querétaro. His lines of research deal with innovation management, technology transfer, ICT and intelligent territories, among others. He is a member of the National System of Researchers, at the candidate level. E-mail: raul.alvarado@uaq.mx

Introduction

In view of their impact and relevance in the various areas of human activity, as well as in current productive activities, information and communication technologies are becoming increasingly important. These technologies comprise the materialization of a technological revolution, which Pérez (2004) describes as an accumulation of knowledge, techniques and technologies that crystallized into new products and services which established a new techno-economic paradigm. It is accepted today that technical change and innovation are essential factors in the sustained growth of any nation, which are determined by the generation and accumulation of technological knowledge and its application in priority sectors.

The pioneering works of Bell (1984), Lundvall (1992), Bell and Pavitt (1995), Lall (1992), among others, highlight the importance of technological learning as a trigger for economic development, which is based on the different scientific activities that result in benefits not only at the level of the company, but also of the productive sectors and countries. This learning has its basis in a technological culture, i.e., they are the acquired skills that allow facing new challenges, which are every day faster and, therefore, comprise a competitive advantage (Carvajal, 2011; Ugas, 2011; López-Lemus and Garza, 2018).

The current technological revolution makes it necessary to turn ICTs into an engine for development and inclusion (Pérez and Sarrate, 2011), to guarantee access and, above all, their social appropriation at all levels and in all spheres (international, national, academic and industrial). ICTs can have potential impacts on organizations and society as a whole; the challenge is to effectively transfer their functionalities and applications to specific practices, and deploy them in different activities: social, recreational, cultural and productive.

The purpose of this research is to analyze the stimulus to the appropriation of ICTs at the organizational level, by means of the implementation of the public policy called Program for the Development of the Software Industry and Innovation (Prosoft, by its acronym in Spanish), which was created in Mexico in 2004. The assumption is that the appropriation of technology and knowledge in organizations derives from learning activities and the construction of technological capabilities, and one way is to implement public policies such as the one under examination here.

In view of scarce studies on this subject, this research is based on the information available from the evaluations conducted by the National Council for the Evaluation of Social Development Policy (CONEVAL, by its acronym in Spanish) and the certifications of the NYCE Normalization and Certification company, through the process model for the software industry (MoProsoft).

The article is structured as follows: first off, the concepts related to the topic, such as learning, capabilities and technological appropriation, are analyzed; secondly, the data of the case study (public policy to promote the ICT sector) are presented; thirdly, the

methodology applied in this research is explained; then, some results are discussed and, finally, conclusions are drawn.

Reviewing concepts

Technological learning

Technological learning in a favorable social, economic and cultural context makes it possible to maximize the opportunities offered by innovation. The mechanisms and strategies for the generation and accumulation thereof are diverse (as will be described below), and the challenge for organizations is to make the most of the learning that is created at the individual and collective level.

Different fields of social sciences have shown that technological learning in organizations (companies, governments and universities) determines, in certain time and circumstances, their competitiveness and permanence in the market, i.e., their survival in the face of a complex and competitive scenario such as the one presented in current economic systems (Carvajal, 2010; López-Lemus and Garza, 2018).

From the innovation economics approach, technological learning is established as a driving force for competitiveness and innovation, defined as a social, cumulative, systemic and deliberate process (Lall, 1992; Bell and Pavitt, 1995).

Dodgson (1993) stresses that organizational learning is a central factor in economic and social systems, which becomes relevant when focusing on the skills and potential of workgroups, since, in the current technological revolution, the fundamental element is learning and, above all, learning which is socialized. Olivé (2010) assures that these processes can be disseminated through tacit or codified forms.

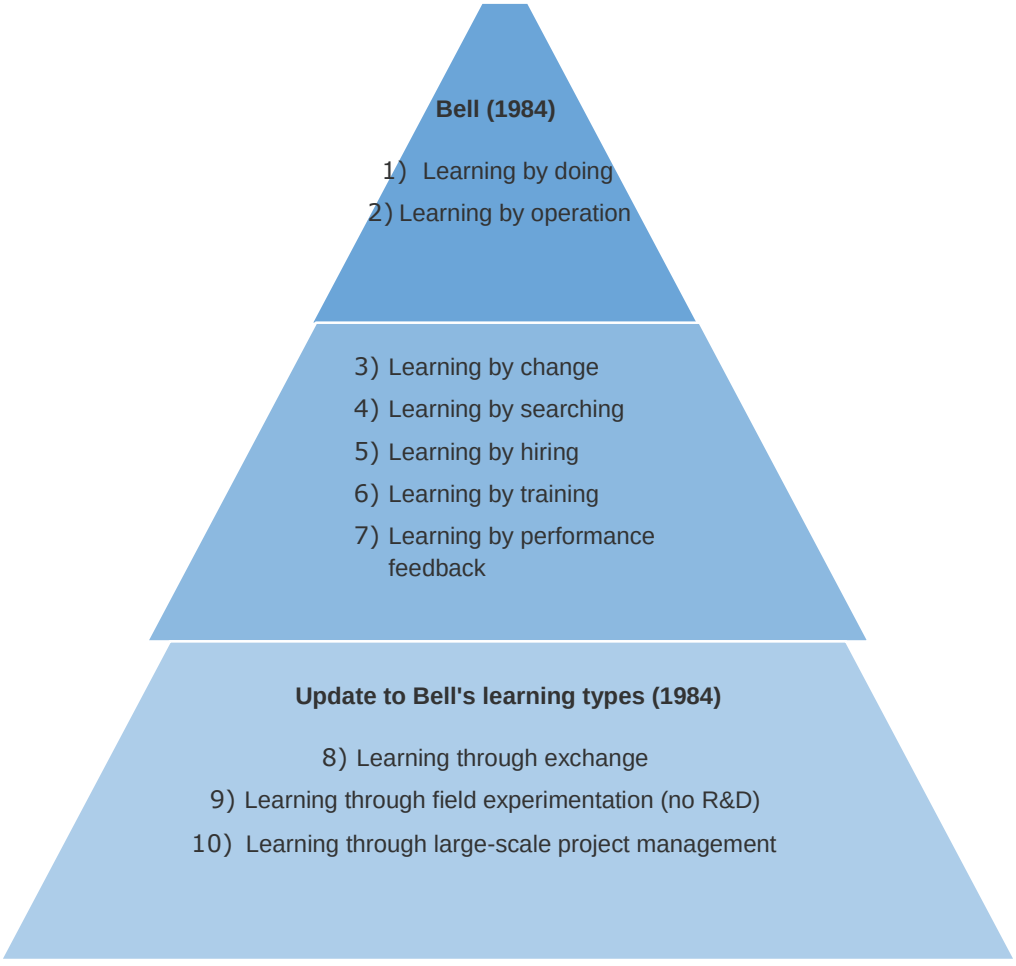
Social learning is a process whereby skills are strengthened and capacities created for the use and appropriation of knowledge by individuals, communities or organizations that give rise to change and progress (Chaparro, 2001). For this reason, organizational or social (collective) learning is more than the sum of individual learning; the central part of its competitive advantages include the accumulation of knowledge, both tacit and codified (Alvarado, 2015).

Technological learning, according to Bell and Pavitt (1995), refers to the knowledge and skills required by agents, among which Learning by doing, derived mainly from a feedback process, and Learning by using, which is based on practice, stand out. In general terms, these two types of learning are the most relevant for developing countries, but it is not

limited to them. Bell (1984) classifies ten main types of technological learning in organizations that are determinant factors for the appropriation of this knowledge (see figure 1).

Another important learning to be highlighted is learning by interacting, which derives from the link between the different actors (suppliers, clients, universities, among others) involved in the productive process, especially in emerging or constantly evolving sectors, as in the case of the ICT sector. Bell (1984), Bell and Pavitt (1995), Kim (1997) and Kim (2000) have stressed the importance of the generation of domestic knowledge in organizations, highlighting that a greater effort to generate and accumulate endogenous knowledge leads to more efficient processes for the appropriation of technology.

Figure 1. Ten types of learning by organizations in developing countries



Source: developed by the author with data from Marcelle, 2004.

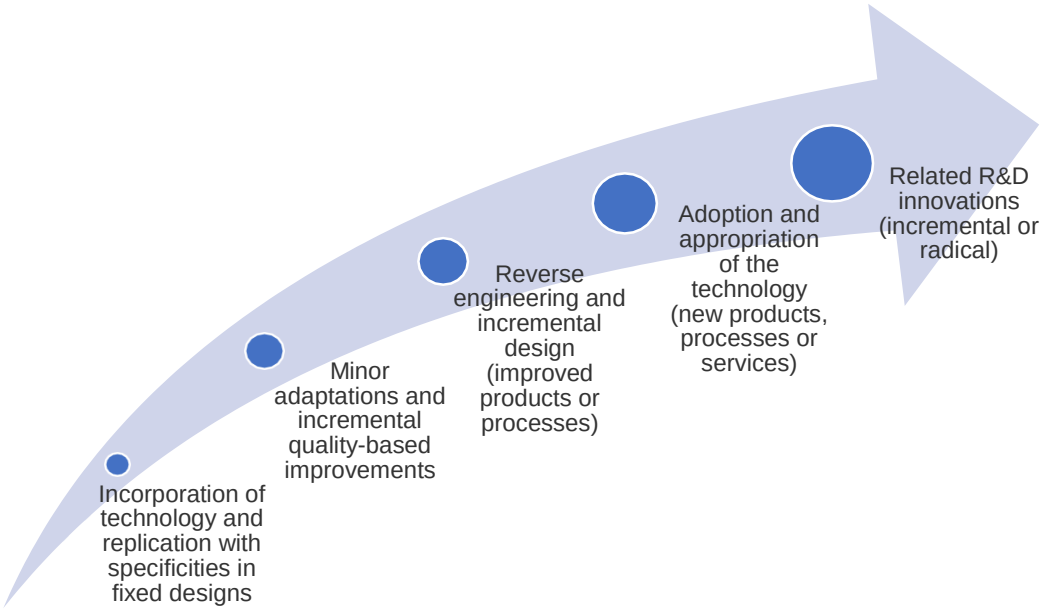
Finally, it should be emphasized that learning processes cannot be forced or imposed by others, as they require will and incentives (Garzón and Ibarra, 2013). This is where government-driven programs constitute one of the main instruments to encourage learning processes that lead to innovation.

Technological capabilities

The founding authors of the technological capabilities concept were Bell and Pavitt (1995), who define them as such practices that make technical change and innovation possible within the productive activities of the organization, which are the result of intentional actions and which accumulate over time. In this sense, Kim (2000) describes these capabilities as those that make the incorporation of new technology and its subsequent improvement possible to meet new market demands.

Therefore, it is important that different organizations such as the government, universities and the productive sector make greater efforts to build greater technological capabilities to ensure competitiveness in an increasingly globalized world. For Kim (1997 and 2000), the generation of innovations (both radical and incremental) based on the relevant technological capabilities that make effective processes of appropriation of knowledge and technology a reality is transcendental. An example of this can be seen in figure 2.

Figure 2. Technological capacity building process



Source: developed by the author with data from Lall (1992) and Bell and Pavitt (1995).

Acquisition and construction of technological capabilities are grounded in the activities and efforts aimed to face the great challenges of creating new productive processes, new services and even new industries (Dutrénit and Vera-Cruz, 2001; Carvajal, 2010; Hernández, 2017). Technological capabilities drive appropriation by means of the development of collateral activities such as knowledge and technology spillovers to society. An example of this is the boost to the use and appropriation of ICTs, both in industry and society.

It should be noted that, due to their characteristics, technological capabilities are not homogeneous in organizations and even less so in productive sectors or countries. For this reason, the lag of developing countries is centered on the fact that they do not learn with the same dynamics as developed countries; that is, their learning, technological capabilities and level of appropriation is lower due to the low education level (cognitive gaps), as well as economic and competitive inequalities (technological gaps).

Technology appropriation

For Lundvall (1992), technology appropriation is a learning process which includes the organizations involved, namely institutions and norms (social and institutional environment). In this sense, Malerba (2008) points out that "Lundvall considers the national innovative system as a space in which interactive learning and relationships between customers and suppliers take place, which can favor or hinder innovation and the accumulation of competences" (p. 5), as well as technological capabilities.

However, as Lundvall (2005) points out, although the concept of "system" appears in different political and academic discourses, the truth is that it focuses on society and its results, that is, on co-evolution and self-organization leading to more and better results for all, which is determined by the capacity to use, adapt and appropriate knowledge and technology. This appropriation in the social and private context derives from processes of interaction and learning. In this regard, Taboada, García and Martínez (2012) point out the following:

> Technological appropriation is the result of the interaction between science, technology, social actors and their environment. This includes the articulation, production, appropriation, transfer and exchange of scientific and technological knowledge. […] It implies a more intensive use of knowledge and information in the specific social sphere to facilitate experimentation and learning at the educational, governmental and entrepreneurial levels (p. 269).

For technological learning to crystallize into a component of change, knowledge must be incorporated by the different agents involved (individuals, companies, universities) and permeate all socioeconomic spheres. In this sense, Chaparro (2001) points out that innovation is possible thanks to the process of private and social appropriation based on knowledge.

Private appropriation of knowledge and technology is understood as the efforts of incorporation and adoption by the private sector, and from which innovations derive which can be gradually disseminated to society, thus having an impact on appropriation processes in favor of social development.

For Chaparro (2003), the importance of moving from private appropriation to a process of social appropriation in which individuals, organizations and institutions participate, lies in turning knowledge into a general good to face the various challenges in the social and economic spheres. In this sense, Taboada, García and Martínez (2012) stress the importance of seeking mechanisms to disseminate and appropriate knowledge, such as the establishment of collaborative networks.

The issue of the social appropriation of technology is not a new development, nor is it limited only to ICTs, since what is important is to impose a social character on technology, i.e., that technology generates value in the social, economic and even environmental contexts. This is in accordance with the complex web of interactions that arise through needs, desires, possibilities and resources (Sagástegui, 2005).

By means of the efforts of different actors (economic and social) and by the support of public policies, it is possible to promote the development of those priority sectors or areas that address major national problems, with aimed to ensure better development, based on technological appropriation.

Appropriation of ICTs in different sectors is paramount in the development process of today's societies. According to David and Foray (2002), knowledge societies and economies are based on their potential to acquire and generate science and, above all, to socially appropriate it. Thus, according to Sagástegui (2005), social appropriation of technology gives it a special meaning for the benefit of individuals, organizations and countries.

Organizations seeking to compete on the basis of innovative activities, especially in the ICT sector, need to create learning processes which systematically boost technological capabilities and, therefore, the appropriation of knowledge and technology. In this regard, Ordóñez and Navarrete (2015) point out that in the context of the technology and information technology sector in Mexico, there is an urgent need to diversify the benefits to companies (especially small and medium-sized ones) and society, which necessarily requires the implementation of plans, programs and public policies aimed at encouraging innovative processes with local benefits.

Case study: public policy to boost the ICT sector

As a result of their dissemination and permeability, ICTs have been described as a technological revolution (Pérez, 2004) due to their multifactorial and multilevel nature; for this reason, it is crucial to know and study their impact on society and on industry (Echeverría, 2008).

In Mexico, in 2004 the Ministry of Economy created Prosoft, a public policy aimed at promoting the ICT sector and encouraging strategic sectors to consolidate the role of small and medium-sized companies, in order to increase their productivity based on innovative activities. It is important to emphasize that there have been other plans and programs aimed at companies and organizations that participate in the ICT sector, such as the Innovation Incentives and Innovation Fund programs of the National Council for Science and Technology (CONACYT, by its acronym in Spanish); however, due to its importance and the scope of this paper, only Prosoft will be analyzed.

Prosoft[1] was created in response to the international challenge of achieving sustained economic growth and, therefore, higher levels of social prosperity through the appropriation and use of ICTs. In this sense, it highlights the importance of promoting government initiatives that favor collaboration and complementarity between the different agents in priority areas, in order to guarantee greater economic and social benefits (Taboada, García and Martínez, 2012).

In 2013, the federal government created the National Digital Strategy (EDN, by its acronym in Spanish), with the aim of promoting the adoption and development of ICTs in the different activities of individuals, organizations and the government, which would result in benefits that would translate into a higher quality of life (Gobierno de la República, 2013a).

Prosoft was integrated to the EDN initiatives within the "Digital Economy" objective, through which it sought to "detonate innovation and entrepreneurship ecosystems to boost an economy that stimulates competitiveness and the emergence of more companies related to the sector" (México Digital, 2018). In 2016, Prosoft was merged with the Sector Innovation Fund, and gave rise to a new name: Prosoft 3.0 (which for practical terms will continue to be simply called Prosoft).

Since then, Prosoft has sought to encourage the promotion, development and adoption of ICTs in the country's priority sectors by establishing five strategies: 1) training of specialized human capital; 2) technological development; 3) financing for companies in key sectors; 4) generation of specialized infrastructure; and 5) dissemination of knowledge. The program establishes three specific areas: mature areas, which include metal mechanics, textiles and leather, iron and steel, among others; dynamic areas, which include auto parts and automotive, electronics, electrical, space and others; and finally, emerging areas, such as biotechnology, medical devices, ICT and the creative sector.

Prosoft considers the linkage between different actors, in order to reduce administrative costs and make a more efficient use of resources through two schemes:

- The first one, aimed at the educational sector, which establishes the formation of consortiums throughout the country called Industrial Innovation Centers (CII, by its acronym in Spanish), integrated as semi-public innovation ecosystems and can be housed in universities or public research centers, and thus encourage the formation of highly qualified human capital (Secretaría de Economía, 2018).

- The second one, focused on the productive sector, which seeks to supplement the efforts of medium or large companies seeking to create CIIs aimed at training specialized human resources that offer knowledge-intensive services, with the objective of moving towards Industry 4.0 (which includes technologies related to the internet of things, data science and artificial intelligence) and making the different industrial sectors more competitive (Secretaría de Economía, 2018).

Prosoft seeks to establish an innovative process, based on the appropriation of technology and knowledge through the interaction of the different agents related to the industry (customers, suppliers, universities), in order to increase learning and innovation in the sector at the local and national level.

Methodology and data

The methodology applied in this research is an exploratory-descriptive analysis of the data collected in the specific performance evaluation reports of Prosoft, published by CONEVAL to analyze the results of the program during the years 2013 and 2018. The information of the Prosoft beneficiary companies that were ruled from 2006 to 2019 under the NMX-I-059/2-NYCE standard, which is a certification carried out by the company Normalización y Certificación NYCE, is also taken up. This certification is a process reference model that evaluates good practices in engineering management in software industry companies.

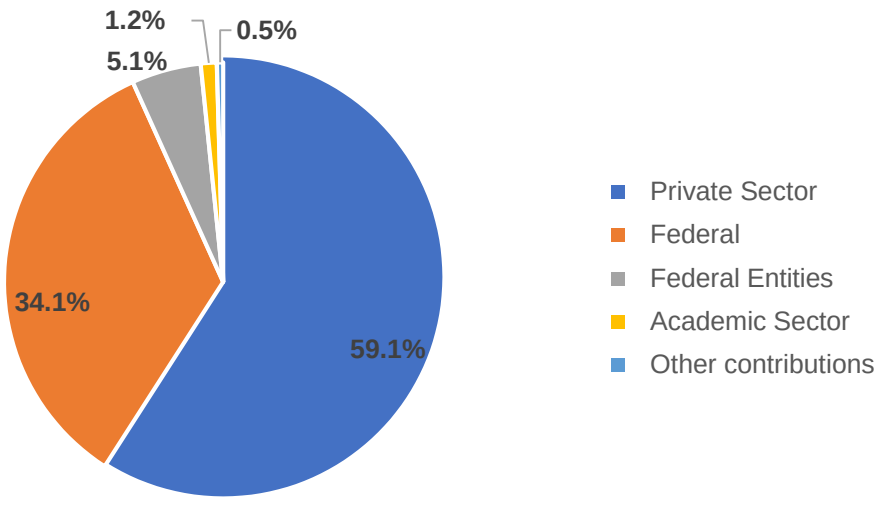
The analysis shows the performance of the program from its origin and the evolution thereof both regarding its scope and objectives and strategies to strengthen the ICT sector and the appropriation processes of the participating actors.

Analysis and discussion of results

According to the México Digital portal (2018), in recent years the Prosoft program supported 1,358 projects in the ICT sector during the period 2013-2016, with contributions from the private sector amounting to 5,090.17 million pesos, while the federal contribution was 2,940.57 million pesos; the participation of the federal entities was 441.87 million pesos; while the contribution of the academic sector was 101.19 million pesos and finally other sources participated with 39.66 million pesos. The percentage of contributions is shown in chart 1, where the private sector stands out with an amount close to 60%, while the federal contribution[2] represented a little more than 34% of the total.

According to CONEVAL (2017), from 2013-2016 Prosoft granted resources mainly to the business sector (from different development areas) and the educational field, such as Research and Development (R&D) centers and universities, which were aimed at strengthening strategic areas and innovation activities. CONEVAL (2017 and 2018) highlights that, despite the program's lifespan, it lacks strict performance evaluations, which has limited knowing more about its impacts. However, through the program's Results Indicator Matrix (MIR, by its acronym in Spanish) that CONEVAL (2017 and 2018) itself develops, it is described that positive results have been presented, for example, in the 2016-2017 evaluation report it is noted that, out of 138 countries, Mexico ranked 67th in the dynamism of the ICT sector.

Chart 1. Percentage of contributions of the PROSOFT 3.0 program, by entity or sector (2013-2016)



Source: developed by the author with data from Secretaría de Economía (2018) and México Digital (2018).

CONEVAL (2017) stresses that during 2016 beneficiary organizations (companies, universities, research centers) did not have the best progress in innovative processes in the ICT sector, and upon receiving the Prosoft contribution they evidenced a higher level of productivity and adoption of ICTs.

In 2017, adjustments were made to the general objective of the program, in order to create collaborative systems for innovation through the participation of civil society, academia and the productive sector.[3] The support provided sought to encourage the creation of semi-public CIIs, thus promoting the training of human resources (professionals, technical operators, among others) highly qualified in the design and use of ICTs for the benefit of industry and national development.

As of 2018, the program had a coverage of 25 entities served, 74 municipalities and 90 locations,[4] focusing its support mainly on small and medium-sized enterprises, as well as universities and R&D centers.

In 2018, Prosoft supported fourteen projects dedicated to the creation of semi-public CIIs; the federal resource provided was 191.26 million pesos (México Digital, 2018). It should be noted that the interest in establishing and equipping CIIs is based on the importance of Learning by interacting in the innovative process, which involves the evolution of knowledge through the collective learning process (Lundvall, 1992 and 2005).

CIIs are characterized by their collaborative processes and complementarity of capacities of the participating organizations, by having a shared infrastructure for R&D activities and the training of specialized human capital, which strengthen strategic sectors and guarantee access to and use of software in favor of competitiveness (CONEVAL, 2018). The formation of such centers is based on the linkage of the productive sector, academia and government, better known as the triple helix model (Edquist, 2002).

According to CONEVAL (2018), between 2008 and 2017, the target population served fluctuated around the levels proposed by the program; however, with the 2017 budget adjustment, Prosoft suffered a 77.6% drop with respect to 2016, which meant a reduction in the number of approved projects and, therefore, in coverage (only twelve municipalities in nine federal entities were served).

Analysis of the results of the NMX-I-059/2-NYCE standard

The Prosoft program established the importance of having certifications and quality standards that would help determine indicators of adoption and production of goods or services by the program's beneficiaries. The certifications most commonly used by the program are three, which are shown in table 1 with their main characteristics.

Table 1. Characteristics of the main Prosoft certifiers

Certifying company	Brief description
Process Model for the Software Industry (MoProsoft)	Model designed with the support of the Faculty of Sciences of the UNAM, which focuses on the progress and evaluation of processes and monitoring of systems and products, with the objective of indicating the level of maturity in the capabilities of Mexican SMEs
Capability Maturity Model Integration (CMMI)	Model focused on processes, development, maintenance, adoption and use of software. It was initially created for Carnegie-Mellon University, aimed at the analysis, development and implementation of software for large companies
Team Software Process (TSP) Performance and Capability Evaluation (PACE)	Establishes the guidelines for a team in the formulation of its objectives and process planning so that the organization can create advanced engineering practices, guaranteeing efficient and quality products

MoProsoft is a model developed in Mexico specifically by the Ministry of Economy, which is aimed at analyzing the maturity of capacity building in the ICT sector of small and medium-sized enterprises, which are the predominant ones in our country. In addition, the model has certified more than 70% of the beneficiaries of the program, for this reason and for the information available in this study, only this certification is analyzed.

MoProsoft determines six levels ranging from 0 to 5, where 0 is associated with the lowest level of capability (objectives not achieved), while 5 means that the planned objectives have been achieved through optimization and continuous improvement of processes in the company; that is, at the highest level the organization has managed to accumulate certain technological capabilities and, therefore, consolidated ownership. Table 2 shows the levels considered by MoProsoft and their attributes.

Table 2. MoProsoft Capability Levels and Process Attributes

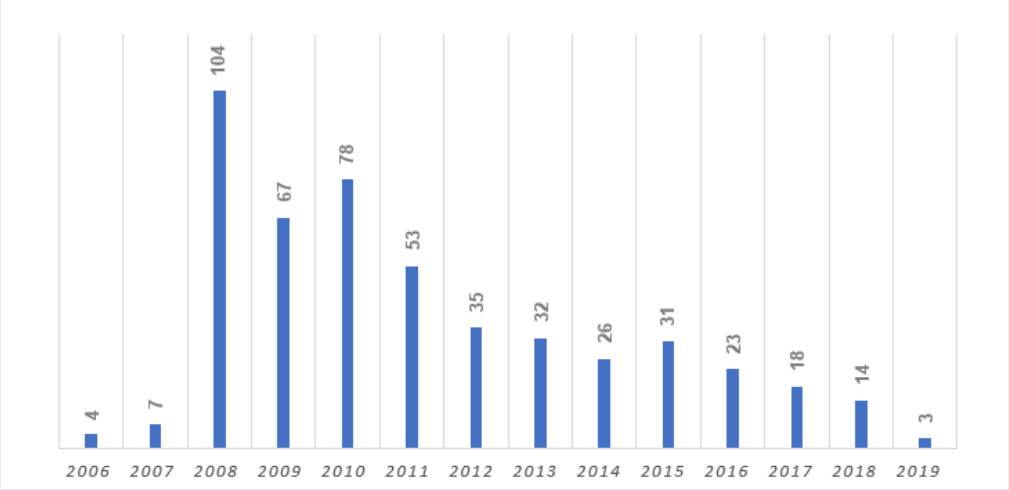
Number	Level	Attributes
0	Incomplete	N/A
1	Completed	Execution of the process
2	Managed	a) Process administration b) Product management
3	Established	a) Process analysis b) Resource analysis

Number	Level	Attributes
4	Predictable	a) Measurement b) Control
5	Optimized	a) Change b) Improvement

Source: Miramontes, 2016.

According to the data provided by Normalización y Certificación NYCE, 495 certifications were made to companies through the NMX-I-059/02-NYCE standard, in the period 2006 to 2019 (with cut-off as of January 16, 2020), and it stands out that there are companies that have been certified on more than one occasion in different years (Normalización y Certificación NYCE, S.C., 2018 and 2020). The certifications can be seen in chart 2.

Chart 2. Certifications per year under MoProsoft (2006-2019)



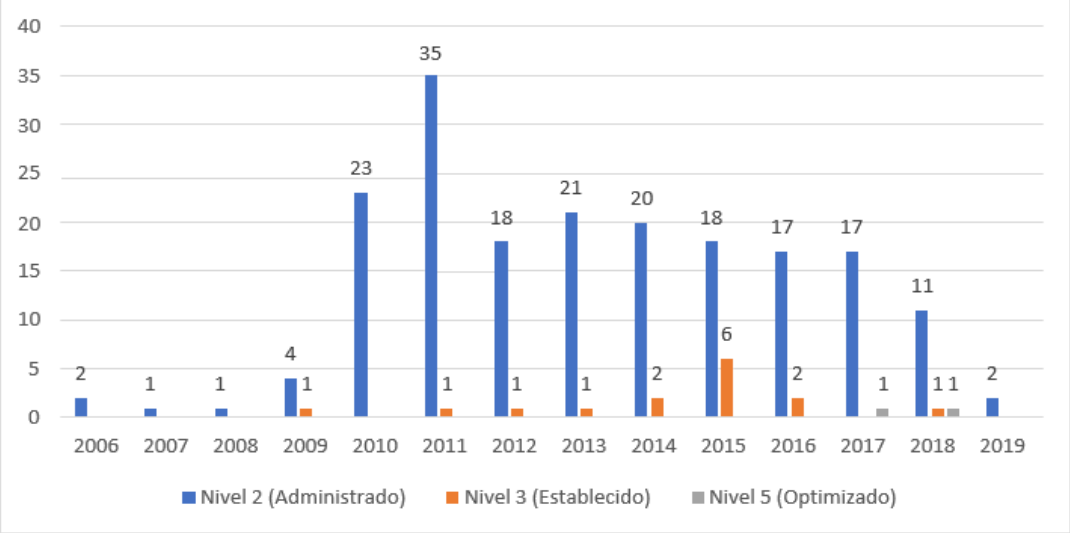
Source: developed by the author with data from Normalización y Certificación NYCE, S.C. (2018 and 2020).

It should be noted that the Prosoft operating rules establish level 2 as a minimum, which would be an sign that beneficiary companies have met the objective of adoption and appropriation of ICTs. In this sense, it should be pointed out that according to data from NYCE Standardization and Certification, S. C. (2018 and 2020), only one company reached level 2, out of the 104 certified in 2008, the year with the highest number of registrations. Another contrasting data is that in 2011, 35 companies reached level 2 and one reached level 3, out of

the total of 53 companies certified in that year. Chart 3 shows the number of companies that reached level 2 or higher during the aforementioned period.

When comparing charts 2 and 3, it can be observed that since 2011 there has been an increase in the number of certifications that reach level 2, which represents about 50% in each year; with this it can be deduced that in most of the companies a learning process or technological appropriation has been consolidated by achieving the minimum optimal level proposed by Prosoft. It should be emphasized that only one company has achieved the maximum level (level 5): in 2017 and 2018, Lobo Software, S. A. de C. V., who since its first certification in 2014 reached level 3, which it maintained during 2015 and 2016.

Chart 3. MoProsoft certifications at level 2 and above



Source: developed by the author with data from Normalización y Certificación NYCE, S. C. (2018 and 2020).

There are other companies that have shown a slower process but have gradually climbed up the levels (from 1 to 3 mainly), as is the case of Consultores en Sistemas Informáticos de RH S. A. de C. V., Gopac Soluciones Integrales, S. A. de C. V., Lasad Soluciones Integrales S. A. de C. V., to mention a few. In this sense, with the support of Prosoft, companies in the software industry in Mexico meet their challenges to meet the demands of the ICT market with more and better services and products. The importance of certifications for Prosoft beneficiary companies is that they can be linked to the fulfillment of the program's objectives.

It is necessary to point out that for many small and medium-sized companies the support provided by programs such as Prosoft is vital, as it allows them to foster the

appropriation of knowledge and technology, essential factors to ensure their competitiveness. As Edquist points out:

> Although innovation-oriented public policy tends to be selective. Policy is a matter of governing, directly or by influencing the incentive structure of the actors (and, therefore, their behavior) [...]. However, the degree to which public policy meets its objectives its selectivity degree is much greater (2002, p. 6).

By designing and implementing plans and programs aimed at addressing priority sectors, such as the one analyzed here, the aim is to break with the idea of the linear model of innovation where science and R&D are the responsibility of the State, in public research centers (based on basic science). The innovative process, in reality, depends on the interaction and complementarity of the different actors (public and private) that make up a national innovation system, where the objective is to make the process of appropriation of knowledge and technology faster and more efficient for the benefit of society as a whole (Neffa, 2000).

Conclusions

Historically, technological changes have transformed current practices in every environment, and ICTs are the best example of this. Their adoption and appropriation is essential to face the challenges and take advantage of the opportunities of the new times at the economic, social and environmental levels. This is undoubtedly based on the learning and innovation processes of both individuals and organizations.

This article provides elements for the analysis of technological appropriation at the level of organizations, considering it as a process derived from learning and the construction of technological capabilities, which can be enhanced through the implementation of proper public policy.

Prosoft seeks through different mechanisms to stimulate the productive and research sectors linked to the ICT sector in Mexico, to act as a catalyst for innovation and productivity processes in different socioeconomic areas. Although the success of this program has been highlighted since its inception (2004), to date there is no information or rigorous impact evaluations to measure the achievements in the process of adoption and appropriation of ICTs by the program's beneficiary organizations, nor its repercussions on society.

However, from an analysis of the certifications of the companies supported by Prosoft, progress can be deduced regarding the adoption and appropriation principle pursued by the program, but even so, a greater effort is required to try to incorporate and design mechanisms to help evaluate its performance and impact on the process of technological appropriation of the supported organizations.

It should be emphasized that since 2019 the program has been in the process of evaluation and budget adjustments, in order to adapt the coordination and operation mechanisms to the new reality of austerity and, above all, to guarantee efficiency and effectiveness in the application of the public budget.

It is necessary to mention that it is essential to continue advancing in the improvement and scope of this type of policies, which recognize the role of the appropriation of knowledge and technology in the innovative process of organizations. However, this will be determined by their capacity to take advantage of opportunities and establish the best technological and organizational practices that will allow them to guarantee their competitiveness.

Given the importance of ICTs, it is important to ensure that they become a factor for change and inclusion in both the social and economic spheres. In this sense, one of the advantages of Prosoft, being a public policy at the federal level, is that it can cover the entire national territory, even though it is aimed at the ICT sector, and although it has focused mainly on some states with a greater vocation for technology, with the new strategy for consolidating the CIIs it will be possible not only to strengthen the industry but also the regions where they are located.

Finally, it is important to emphasize that it is a priority to develop more and better indicators to evaluate the performance and results of the different organizations related to the ICT sector in order to improve this and other plans, programs or public policies and to make Mexico a central player in the sector.

REFERENCES

Alvarado, R. (2015). *Capacidades tecnológicas del sector eólico en México: Análisis y perspectivas* (tesis doctoral). Universidad Nacional Autónoma de México, Ciudad de México, México.

Bell, M. (1984). Learning and the Accumulation of Industrial Technological Capacity in Developing Countries. In M. Fransman and K. King (eds.) *Technological Capability in the Third World* (pp. 187-209). London: Macmillan.

Bell, M. and Pavitt, K. (1995). The Development of Technological Capabilities. In I. U. Haque (ed.) *Trade, Technology and International Competitiveness* (pp. 69-101). Washington: World Bank.

Carvajal, Á. (2010). Las capacidades tecnológicas como base para el desarrollo. *Actualidades Investigativas en Educación*, *10*(1), 1-19. https://www.redalyc.org/articulo.oa?id=44713068010&idioma=es

Carvajal, Á. (2011). La cultura tecnológica como base de las capacidades y el aprendizaje tecnológico. *Revista Humanidades*, (1), 1-13. https://www.redalyc.org/pdf/4980/498050304004.pdf

Chaparro, F. (2001). Conocimiento, aprendizaje y capital social como motor de desarrollo. *Ciência da Informação*, *3*(1), 19-31. http://www.scielo.br/pdf/ci/v30n1/a04v30n1.pdf

Chaparro, F. (2003). Apropiación social del conocimiento, aprendizaje y capital social. 1-14. https://cmapspublic2.ihmc.us/rid%3D1HP0C7ML6-1BSFXDZ-814L/apropiaci%25C3%25B3n%2520social%2520chaparro.pdf

Consejo Nacional de Evaluación de la Política de Desarrollo Social (CONEVAL). (2017). *Ficha de Monitoreo 2016-2017, Programa para el desarrollo de la industria del software (PROSOFT) y la innovación.* https://www.coneval.org.mx/Evaluacion/Documents/EVALUACIONES/FMyE_2016_2 017/FMyE_10_S151.pdf

CONEVAL. (2018). *Ficha de Monitoreo 2017-2018, Programa para el desarrollo de la industria del software (PROSOFT) y la innovación.* https://www.gob.mx/cms/uploads/attachment/file/389972/fmye_prosoft.pdf

CONEVAL. (2020). *Consideraciones para el proceso presupuestario*. https://www.coneval.org.mx/Evaluacion/IEPSM/Paginas/Consideraciones2020.aspx

David, P. and Foray, D. (2002). Una Introducción a la Economía y a la Sociedad del Saber, *Revista Internacional de Ciencias Sociales*, *171*(s.f.), 1-22. https://issuu.com/rodolfocarpio/docs/una-introduccion-a-la-economia-y-a-la-socieda d-del

Dodgson, M. (1993). Organizational Learning: A Review of Some Literatures. *Organizational Studies*, 14(3), 375-394.

Dutrénit, G. and Vera-Cruz, A. (2001). *Aprendizaje, Conocimiento y Capacidades Tecnológicas*. Monografía núm. 2 del proyecto Aprendizaje Tecnológico y Escalamiento Industrial. Generación de Capacidades de Innovación en la Industria Maquiladora de México. México: COLEF/FLACSO/UAM.

Echeverría, J. (2008). Apropiación social de las tecnologías de la información y la comunicación. *Revista Iberoamericana de Ciencia, Tecnología y Sociedad*, *4*(10), 171-182.

Edquist, C. (2002). Innovation Policy—A Systemic Approach. In Archibugi, D. and Lundvall, B. (eds.) *The globalizing learning economy* (pp. 219-238). Oxford: Oxford University Press.

Galicia, R. (2015). PROSOFT 3.0. *Revista de Tecnologías de la Información*, 2(4), 217-221. http://www.ecorfan.org/bolivia/researchjournals/Tecnologias_de_la_Informacion/vol2num4/Revista%20de%20Tecnolog%C3%ADas%20de%20la%20Información%20V2%20N4_4.pdf

Garzón, M. and Ibarra, A. (2013). El aprendizaje tecnológico como acelerador de la innovación. *Escenarios 11*(1), 57-77. https://dialnet.unirioja.es/servlet/articulo?codigo=4714372

Gobierno de la República. (2013a). Estrategia Digital Nacional. https://www.gob.mx/cms/uploads/attachment/file/17083/Estrategia_Digital_Nacional.pdf

Gobierno de la República. (2013b). Plan Nacional de Desarrollo. https://itcampeche.edu.mx/wp-content/uploads/2016/06/Plan-Nacional-de-Desarrollo-PND-2013-2018-PDF.pdf

Hernández, J. (2017). Capacidades tecnológicas y organizacionales de las empresas mexicanas participantes en la cadena de valor de la industria aeronáutica. *Economía teoría y práctica*, *47*, 65-98. http://www.scielo.org.mx/pdf/etp/n47/2448-7481-etp-47-00065.pdf

Kim, L. (1997). *From imitation to Innovation. The Dynamics of Korea's Technological learning.* Boston, Mass: Harvard Business School Press.

Kim, L. (2000). The Dynamics of Technological Learning in Industrialisation. *Discussion Paper Series 2000-07, United Nations University-INTECH*, 1-33. https://archive.unu.edu/hq/library/Collection/PDF_files/INTECH/INTECHdp2007.pdf

Lall, S. (1992). Technological Capabilities and Industrialization. *World Development, 20*(2), 165-186. https://www.sciencedirect.com/science/article/abs/pii/0305750X9290097F

López-Lemus, J. and Garza, M. (2018). Tecnología y aprendizaje organizacional factores influyentes sobre la satisfacción profesional en residentes de pregrado. *Actualidades investigativas en educación*, *18*(2), 1-23. https://www.scielo.sa.cr/pdf/aie/v18n2/1409-4703-aie-18-02-285.pdf

Lundvall, B. (1992). (ed.) *National Systems of Innovation: towards a theory of innovation and interactive learning*. London: Pinter Publishers.

Lundvall, B. (2005). National Innovation Systems—Analytical Concept and Development Tool, en *DRUID Conference* (pp. 1-44). Copenhague, Dinamarca. https://www.researchgate.net/publication/24081600_National_Innovation_Systems-Analytical_Concept_and_Development_Tool

Malerba, F. (2008). La teoría evolucionista: las aportaciones empíricas. In R. Viale. (comp.) *Las nuevas economías. De la economía evolucionista a la economía evolutiva: más allá de las fallas de la teoría neoclásica* (pp. 44-64). Ciudad de México, México: FLACSO.

Marcelle, G. (2004). *Technological learning: A strategic imperative for firms in the developing world.* California: Edward Elgar Pub.

Martínez, R. (2013). *El programa para el desarrollo de la Industria del Software (PROSOFT) como instrumento para la promoción industrial en México* (tesis de licenciatura). Universidad Nacional Autónoma de México, Ciudad de México, México. http://132.248.9.195/ptd2013/junio/0696106/0696106.pdf

México Digital (2018). PROSOFT 3.0. https://www.gob.mx/epn/es/articulos/prosoft-3-0?tab

Miramontes, J. J. (2016). *Método para aligerar procesos de software mediante la optimización en la selección de prácticas de ingeniería de software* (tesis maestría). Centro de Investigación en Matemáticas, A.C., Zacatecas, México. https://cimat.repositorioinstitucional.mx/jspui/handle/1008/535

Neffa, J. (2000*). Las innovaciones científicas y tecnológicas. Una introducción a su economía política.* Argentina: Asociación Trabajo y Sociedad y Lumen-Humanitas.

Normalización y Certificación NYCE, S.C. (2018). Empresas dictaminadas en la norma NMX-I-059/02-NYCE (MoProSoft). https://nyce.org.mx/wp-content/uploads/2018/09/PADRON-DE-EMPRESAS-DICTAMINADAS-EN-LA-NORMA- NMX-I-059-NYCE-MoProSoft-21-09-2018.pdf

Normalización y Certificación NYCE, S.C. (2020). Empresas dictaminadas en la norma NMX- I-059/02-NYCE (MoProSoft). https://www.nyce.org.mx/wp-content/uploads/2020/01/PADRON-DE-EMPRESAS-DICTAMINADAS-EN-LA-NORMA- NMX-I-059-NYCE-MoProSoft-16-01-2020.pdf

Olivé, L. (2010). Filosofía: la innovación ante la sociedad del conocimiento. In: Corona, L. (coord.) *Enfoques de la innovación ante la sociedad del conocimiento* (pp. 58-70). Ciudad de México, México: Plaza y Valdez.

Ordóñez, S. and Navarrete, D. (2015). Industria de servicios de telecomunicaciones y reforma regulatoria en México. *Revista Problemas del Desarrollo*, *184*(47), pp. 35-60. http://www.scielo.org.mx/pdf/prode/v47n184/0301-7036-prode-47- 184-00035.pdf

Pérez, C. (2004). *Revoluciones tecnológicas y capital financiero.* Ciudad de México, México: Editorial Siglo XXI.

Pérez, G. and Sarrate, M. (2011). Las TIC promotoras de inclusión social. *Revista Española de Pedagogía*, *LXIX*(249), 237-254. https://revistadepedagogia.org/wp-content/uploads/2011/05/249-03.pdf

Sagástegui, D. (2005). La apropiación social de la tecnología: un enfoque sociocultural del conocimiento. *Razón y Palabra*, (49), 1-18. http://www.razonypalabra.org.mxwww.razonypalabra.org.mx/anteriores/n49/bienal/Mesa%2012/DianaSagastegui.pdf

Secretaría de Economía (2018). PROSOFT 3.0. https://prosoft.economia.gob.mx

Taboada, E., García, A. and Martínez, A. (2012). Apropiación del conocimiento, innovación e interacción entre agentes: elementos clave para diseñar y promover políticas de innovación. In A. Martínez, R. de Gortari, H. Vessuri y A. Vega (coords.) *Apropiación social del conocimiento y aprendizaje: una mirada crítica desde diferentes ámbitos* (pp. 259-280). https://www.researchgate.net/publication/313476849_Apropiacion_social_del_conocimiento_y_aprendizaje_una_mirada_critica_desde_diferentes_ambitos

Ugas, L. (2011). Aprendizaje tecnológico e informacional para desarrollar una cultura de enseñanza en organizaciones inteligentes. *Revista del Centro de Investigación de Ciencias Administrativas y Gerenciales*, *9*(1), 62-89. http://ojs.urbe.edu/index.php/cicag/article/view/578/495

[1] Prosoft has its antecedents since 2002, as a program of the Ministry of Economy, aimed at promoting ICT in Mexico and which was materialized in 2004 as version 1.3 (covering from 2002 to 2008). However, 2008, Prosoft is modernized thanks to the loan granted by the World Bank in order to promote the consolidation of the IT sector in Mexico with which it acquired the name of Prosoft 2.0 (Galicia, 2015; Martínez, 2013)

[2] According to the portal México Digital (2018), the federal resource during the referred period (2013-2016), managed to be boosted 2.93 times.

[3] The strategic sectors are established in the Innovative Development Program (2013-2018) (PRODEINN) (Gobierno de la República, 2013b).

[4] The Program was aligned with sectoral objective 2 of the Innovative Development Program (2013-2018) which refers to "Implementing a policy that promotes innovation in the trade and services sector, with emphasis on knowledge-intensive companies".