

THE INFLUENCE OF INFORMATION AND COMMUNICATION TECHNOLOGIES ON ORGANIZATIONAL INNOVATION. A PERSPECTIVE OF MEXICAN SMES

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Abstract

The adoption of new organizational methods is essential for any firm to improve its ability to seize and create new knowledge, which is necessary to develop alternative types of innovations. Hence, the appropriate use of Information and Communication Technologies (ICTs) can substantially improve organizational innovation. In this sense, an empirical study of 288 manufacturing SMEs in the Guanajuato region, Mexico, was conducted to determine the influence of ICTs usage on organizational innovation in a developing country. The results obtained through the Structural Equation Modeling demonstrate that the use of ICTs substantially impacts on organizational innovation. Therefore, SMEs should use ICTs effectively and collaboratively with suppliers and customers to meet market trends and improve or innovate their products.

Keywords: Use of ICTs, Organizational Innovation, Collaboration, Manufacturing SMEs, Structural Equation Modeling

1. INTRODUCTION

By the end of the last century, the environment and high competence among organizations have pushed small and medium enterprises (SMEs) to establish their business strategies not only as a form to obtain new profits or to survive but to grow and produce new benefits. For that reason, decision makers in this kind of enterprises are forced to change its business perspective, which is fundamental to act with efficiency and to adequate the use of new technologies that will allow them to achieve success and sustainable growth in the market. In this sense, mainly due to the importance that this type of companies, SMEs, have to the economy of any country, it is fundamental for these to take advantage of resources and capabilities on which they count, in order to face the current business environment in more efficient manner. In the context of Mexico, Cuevas-Vargas et al. (2015) define that adopting Information and Communication Technologies (ICTs) is one of the strategies that SMEs have to implement in order to reduce the threats of globalization, mainly because these technology tools allow them to improve efficiency and competitiveness (Ongori and Migiro, 2010), by playing a central role, especially in this type of companies, to increase competitiveness.

At the same time, ICTs have an important impact on companies, both in developed and emerging countries, such as the case of Mexico. Manocheri et al. (2012) define that ICTs provide new opportunities to companies because it is possible to design and to delivery digital goods, which additionally increment margins and profits,

since the access to international markets increase. Therefore, managers should consider ICTs as technologies that help managing and optimizing business processes, ensuring partial automatization of personnel activities, organizing human resources, improving quality and managing important information for decision-making (Rogers et al., 2011).

During the last years, a great deal of research in the area of ICTs have analysed the complementarity relationship between the adoption of ICTs and the adoption of various organizational innovations (Bresnahan et al., 2002; Hollenstein, 2004). For example, Melville et al. (2004) have differentiated the effects of ICTs on business processes from those on the company as a whole. The first type of effects from ICTs include all measurements taken to improve operational efficiency on the specific business processes, such as quality improvements on design processes, or improvements on the life cycle in inventories management processes.

Dewett and Jones (2001) classify the companies' improvements, which enhance innovation, into five categories: 1) coordination among workers, 2) capacity to codify knowledge of the company, 3) greater capacity to improve its business areas expanding old traditional boundaries of the company 4) processing of information and its effects on efficiency 5) improvement on collaboration and coordination.

However, in the literature review there are only few researches that analyse the ICTs types and its levels in which these allow organizational innovations (Mustafa, 2015; Spiezia, 2011); most of

the researches are focused only on the relationship between ICTs and business innovation (Brynjolfsson and Hitt, 2000; Cuevas-Vargas et al., 2016; Gago and Rubalcaba, 2007; Spiezia, 2011). Therefore, this paper presents two main contributions. The first is to provide empirical evidence about the existing relationship between ICTs and organizational innovation, in the context of manufacturing SMEs in a developing country, such is the case of Mexico. The second is about the application of a different methodology, which is different from previous researches, including a test of the theoretical model through the validation of constructs, using a Confirmatory Factor Analysis (CFA) and hypothesis testing by Structural Equations Modelling (SEM).

In this sense, the present research work proposed the objective to analyse the influence of ICTs usage on organizational innovation, in manufacturing SMEs in Guanajuato region, Mexico. In consequence, it is important that the researcher question if the use of ICT substantially improves organizational innovation in SMEs and what its implications are. From this, the paper presents an application of a survey to 288 manufacturing SMEs in the Guanajuato region, in México, from October to December 2014. This paper is organized in five sections. First, the introduction followed by the literature review and established hypothesis. Third, the research methodology is explained. Fourth, the results and discussion are offered. Fifth, conclusions, implications, research limitations and future research are presented.

2. LITERATURE REVIEW

This paper's research model is about the relationship of ICTs and organizational innovation in SMEs. In this section the theoretical and empirical arguments are explained that are the basis of this research hypothesis:

2.1. Relationship of the Use of ICTs with Organizational Innovation

ICTs are related to the use of hardware devices, software and telecommunications, to store, manipulate, convert, protect, send and receive information (Olifer and Olifer, 2006). Current research suggests that ICTs is a strategic resource that helps companies to find new opportunities in market, with low costs and high probability of success (Shin, 2007). The investigations of Diaz-Chao et al. (2015) propose that in order to SMEs improve its productivity these need public policies that integrally promote ICTs, organizational change, and training to workers and entrepreneurs.

In the current research, there is scientific evidence that indicates that ICTs significantly contribute to efficiency, productivity, and innovation on every company, because the use of ICTs allows production of products in a shorter time, mainly with the support of computing systems. At the same time, there is research defining ICTs' investments as good influences on workforce's productivity and economic growth (Oliner and Sichel, 2004).

Moreover, the OECD Oslo's manual (2005) considers organizational innovation as the application of new methods in a company, which can produce changes in working practices, on work

places or on external relationships. Therefore, the adoption of new organizational methods can improve the attitude of the whole company, by adopting this new knowledge and therefore creating new knowledge that can be used to develop another type of innovations. In this sense, Damanpour (1991) defines organizational innovation as the adoption of a new idea or new action in a company. On the other hand, Alasoini (2001) states that organizational innovation not only includes changes in working structures, internal and external functions in the whole organization, but also in the interactions among them.

Therefore, the organizational structure of a company can influence efficiency of innovation activities mainly because the higher level of organizational integration can improve coordination, planning, and implementation of innovation strategies (OECD, 2005). Likewise, organizational innovation is also an important factor that influences quality and innovation strategies (OECD, 2005). Also, organizational innovation is an important factor that improves quality and innovation performance. Consequently, a more flexible company where workers are empowered for decision-making will be more efficient to generate radical innovations.

According to Chandler (1990) managers, workers and other companies' cooperation are the three internal factors considered as key aspects for SMEs' innovation, since a manager in a SME should prioritize the generation and development of new ideas. The human factor is also fundamental for the development of innovation in SMEs, since the more existing communication levels and the fewer formalization levels in general provide the better workers' autonomy. Therefore, compromise can be seen between the worker and the company, which facilitates creativity, and consequently, more participation in the development of innovation. Finally, the creation of collaboration agreements with other companies will allow SMEs to eliminate its barriers, namely, resources scarcity and non-specialized actives for innovation (Teece, 1986). Hence, cooperation among SMEs becomes a strategic weapon to generate collective networks of knowledge as basis to develop improvements to products, services or processes (Verhees and Meulenbergh, 2004).

Based on Seguy et al. (2010) ICTs can affect all levels of the company and can produce changes in the environment of decision takers and actors, mainly through the acquisition and improvement of information, skills and experience, expansion areas of action, as well as, the possibility of distance work.

In terms of empirical evidence related to the use of ICTs with organizational innovation, there is a positive and significant relationship between these two. For instance, Papaioannou (2004) in his research, exploring the effects of ICTs on productivity and economic growth, in emerging and developed countries, identified that ICTs presented a positive and significant impact onto productivity and economic growth. Another investigation carried out by Polder et al. (2009) it was found that ICTs are important enhancers of innovation on both industries, manufacturing and services, and that Innovation and Development (I+D) has a positive effect on products innovation, in manufacturing

companies; highlighting that organizational innovation had stronger effects from productivity. Finally, there were identified positive effects from products and processes innovation when these were combined with organizational innovation. Whereas, Manochehri et al. (2012) on his research of 102 SMEs in Qatar, he identified, in this type of companies, that had important investment on ICTs because of their need to offer better and faster services to customers, to stay ahead with competence and to follow new management guidelines. Also, the benefits from adopting such ICTs have been reflected on its better relationships with customers and costs reductions. As a result, from this, it is possible to establish the following hypothesis.

H₁: Greater use of ICTs, greater levels of organizational innovation.

3. METHODOLOGY

3.1. Sample Design and Data Collection

An empirical research was performed using a quantitative approach of explanatory and cross sectional type through the statistical technique of Structural Equation Modeling (SEM). For the development of this research it was taken as a reference the database offered by the Business Information System of Mexico (2015), considering a sample of 288 SMEs from 1 to 250 employees in the manufacturing sector in Guanajuato, Mexico, with a confidence level of 95% and a margin of error of 5%. The survey was applied randomly and answered by the managers or owners of these kind of businesses during October-December 2014.

3.2. Measurement of Variables

To measure the use of ICTs, the scale used by González-Gallego et al. (2010) was adapted by adding it 2 items, to make a 16 items scale which was measured with a Likert-type scale of a 1 to 5 point range, which refer from low importance to high importance, and tested in other studies by Cuevas-Vargas et al. (2015). Regarding to the measurement of organizational innovation, an adapted scale proposed by Pinzón (2009) was considered, which is composed of 9 items, measured with a Likert-type scale of a 1 to 5 point range, which refer from total disagreement to total agreement.

3.3. Reliability and Validity

To evaluate the reliability and validity of the scales, a Confirmatory Factor Analysis (CFA) using the maximum likelihood method through the use of EQS 6.1 statistical software was performed, considering both latent variables as first order factors (Bentler, 2005; Brown, 2006; Byrne, 2006). From the obtained results, all values of the scales exceeded the recommended value of 0.7 for *Cronbach's Alpha* which provides evidence of reliability and justifies the internal reliability of the scales (Hair et al., 2010; Nunnally and Bernstein, 1994). The Composite Reliability (CRI) is greater than 0.70 (Fornell and Larcker, 1981), the Average Variance Extracted (AVE) was greater than 0.50 (Fornell and Larcker, 1981) in each and every one of the factors. Also robust statistical testing was used (Satorra and Bentler, 1988) in order to provide better evidence of statistical adjustments, as it can be seen in Table 1.

Table 1. Internal consistence and convergent validity of the theoretical model

Variable	Indicator	Factor Loading >0.6	Robust t-value	Cronbach's Alpha >0.7	CRI >0.7	AVE >0.5
Use of ICTs	IT2	0.808***	1.000 ^a	0.973	0.973	0.722
	IT3	0.849***	31.266			
	IT4	0.859***	26.987			
	IT5	0.890***	22.802			
	IT6	0.833***	18.113			
	IT7	0.884***	23.577			
	IT8	0.824***	18.741			
	IT9	0.854***	20.758			
	IT10	0.846***	20.177			
	IT11	0.818***	18.139			
	IT13	0.878***	21.479			
	IT14	0.884***	23.360			
IT15	0.843***	20.050				
IT16	0.823***	18.510				
Organizational Innovation	ORI1	0.770***	1.000 ^a	0.923	0.920	0.590
	ORI2	0.873***	17.558			
	ORI3	0.825***	15.283			
	ORI4	0.786***	14.683			
	ORI5	0.796***	15.321			
	ORI6	0.690***	10.932			
	ORI8	0.690***	11.438			
ORI9	0.694***	10.671				

S-B X²= 553.122 on 208 df; (S-B X²/df)= 2.65; p= 0.000; RMSEA= 0.079; NFI= 0.912; NNFI= 0.937; CFI= 0.943

^a = Parameters constrained to this value in the identification process; Significance level= *** = p < 0.001; ** = p < 0.05
CRI= Composite Reliability Index; AVE= Average Variance Extracted

Therefore, it was found that the original model showed level adjustment problems, so it was necessary to eliminate three observable variables to the whole theoretical model, two observable

variables to the construct use of ICTs (IT1) and (IT12), and another one to the organizational innovation latent variable (ORI7), due to the fact that their factor loadings were under the value of 0.6 suggested by Bagozzi and Yi (1988), so that the model got a very good adjustment of the data taking into reference robust statistics, since the values of NFI, NNFI and CFI are higher than 0.90 (Bentler, 2005; Brown, 2006; Byrne, 2006; Hair et al., 2010); S-B χ^2/df is lower than 3.0 (Hair et al., 2010); and RMSEA is less than 0.08, which are acceptable (Hair et al., 2010; Jöreskog and Sörbom, 1986), which can be seen in Table 1. Hence, as evidence of convergent validity, the results of CFA indicate that all the items of the related factors are significant ($p < 0.001$), the size of all the standardized factor loadings are

greater than 0.60 (Bagozzi and Yi, 1988).

With regard to the evidence of discriminant validity, the results are presented in Table 2, where the measurement is provided in two forms, the first one with a 95% interval of reliability, below the diagonal numbers (in bold), none of the individual elements of the latent factors of the correlation matrix contains the value 1.0 (Anderson and Gerbing, 1988). Second, above the diagonal the extracted variance between the pair of constructs is lower than its corresponding AVE (Fornell and Larcker, 1981). Therefore, based on these criteria, it can be concluded that the different measurements in this study demonstrate sufficient evidence of reliability and convergent and discriminant validity of the adjusted theoretical model.

Table 2. Discriminant validity measuring of the theoretical model

Variables	Use of ICTs	Organizational Innovation
Use of ICTs	0.722	0.288
Organizational Innovation	0.594 , 0.950	0.590

4. RESULTS

For the statistical results of the research hypothesis, Structural Equation Modeling was performed using the statistical software EQS 6.1, from first order application of CFA (Bentler, 2005; Brown, 2006; Byrne, 2006), with the same variables to check the model structure and get the results that allow us to contrast the raised hypothesis presented in Table 3.

Likewise, the nomological validity of the theoretical model was examined through the Chi-squared test, which consists on comparing the results obtained between the theoretical model and the measurement model, where results indicate that differences between these two models are not significant, which allows to define an explanation about the relationships between the two latent constructs (Anderson and Gerbing, 1988; Hatcher, 1994).

Table 3. Structural Equation Modeling results from the theoretical model

Hypothesis	Path	Standardized Path Coefficients	Robust t-value	R Square
H1: Greater use of ICTs, greater levels of organizational innovation	Use of ICTs → Organizational Innovation	0.620***	9.223	0.384
S-B $\chi^2= 553.119$; $df= 208$; (S-B χ^2/df)= 2.65; $p= 0.000$; RMSEA= 0.079; NFI= 0.912; NNFI= 0.937; CFI= 0.943				

Significance level: *** = $p < 0.001$; ** = $p < 0.05$; * = $p < 0.1$

Thus, in regard to the hypothesis H_1 , the results presented in Table 3 ($\beta = 0.620$, $p < 0.001$), indicate that the use of ICTs has positive and significant impact on organizational innovation, since the use of ICTs impacts positively by 62% on organizational innovation, so that the H_1 is accepted. Therefore, based on the results obtained through the SEM, we can infer that organizational innovation is explained in 38.4% by the use of ICTs, according to the obtained value of R-squared.

Hence, our results are consistent with findings from other empirical research, since it was found that there is a positive and significant impact of the use of ICTs on organizational innovation. Firstly, there is agreement with the findings of Papaioannou (2004) in their longitudinal study about developed and developing countries; they also confirm the findings by Polder et al. (2009) in their study in Netherlands; and finally, they corroborate the results obtained by Manochehri et al. (2012) in their study of SMEs in Qatar.

CONCLUSION

Based on the stated objective it is concluded that the use of ICTs impacts positively and significantly on organizational innovation in manufacturing SMEs in Guanajuato, therefore, the results obtained in this

study are of great value to decision makers of these kind of businesses in a developing country, since the use of ICTs is a fundamental strategy should be considered within the business strategies of an organization, due to the fact that the use of ICTs substantially influence on organizational innovation. Also, it has been found that manufacturing SMEs in Guanajuato have given more importance to the use of ICTs in inventory management, control of production, and to place orders with their suppliers, which has impacted both on the relations with their suppliers, and on quality control of products with their suppliers; neglecting a bit the use of ICTs to exchange documents with customers and the quality of customer service.

For this reason, managers or owners of these businesses should pay special attention to these two variables, because if they take advantage of the use of ICTs to exchange documents (information) with their customers, they may have more contact with their clients, allowing them to meet their needs, requirements and preferences, and in this way to anticipate their needs by offering them innovative products and / or services that enable their firms to stay ahead in the market; likewise, managers should work more with their employees care and customer service, in order to increase the quality of customer service, which can be seen reflected in their

satisfaction and increased purchases, resulting in a good financial performance. In this sense managers are advised to have habits and continuous improvement programs, to focus on service delivery, using ICTs adequately, and have customer service (Cassivi et al., 2008).

Also, it has been found that the use of ICTs has impacted mainly on the following aspects of organizational innovation, namely the introduction of new practices to improve learning and knowledge sharing within the company; the introduction of new training courses and staff training issues that undoubtedly have enabled these organizations improve their organizational innovation. However, it has been found that manufacturing SMEs in Guanajuato, almost completely neglected collaboration with research organizations; and to a lesser extent they have neglected the development of new relationships with other companies or public institutions, as well as establishing new partnerships with suppliers. For this reason, managers should look within their strategies, the collaboration strategy as collaborative activities play an essential role in the development of innovation within SMEs, since collaboration with universities and research institutions (Cohen et al., 2002), suppliers and users of the products and / or services (Lundvall, 1988), and other competitors (Coombs et al., 1996), raises the growth and the chances of success of SMEs (Motohashi, 2008).

In conclusion, managers and owners of these businesses should incorporate the use of ICTs not only as a key element in their business strategies, but also as part of their daily activities. In this sense, depending on the level of implementation of the use of ICTs, this effect will be reflected in increasing their level of organizational innovation, by virtue of the use of ICTs is an enabler of innovation, it allows for better efficiency in organizing tasks and helps to reduce costs and delivery times for orders, brings them closer to their customers and allows them to keep up with the needs and trends of their customers, which can be seen reflected in product or service innovations, which allow these kind of firms to satisfy their customers, improve their sales and increase their profits.

Similarly, they should take special care in collaboration mainly with suppliers, since this type of agents has more information, knowledge and experience of the market, which can be shared with producing companies of goods and services, to improve or innovate products, and thereby generate higher performance in enterprises (Corsten and Felde, 2005).

Within the constraints, one can note that the surveys were answered from the point of view of the managers of manufacturing SMEs in Guanajuato, which may lend itself to subjectivity. It is recommended to replicate the model in other regions with a more representative sample of the different sectors of the economy considering companies with more than 10 and up to 250 workers in order to increase the validity of the model. Finally it is suggested to investigate what would be the effects of organizational innovation in the adoption of ICTs, and how much would improve company performance by incorporating the financing variable, and how the model would behave if we included

control variables such as age and size of the company.

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