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The Relationship between Innovation, Information Communication Technology, and Quality: A Latin American Enterprises Perspective

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Abstract: The new business environment requires organizations, a rethinking of its business strategies, to adapt them to the new business environment that demands a market increasingly globalized and competitive. Therefore, the innovation of Information Communication Technology (ICT) emerge as two essential elements that should be incorporated in the design and implementation of corporate strategies, and these are two factors that improve the quality of the companies, specially the small and medium enterprises (SMEs). In this sense, this study with a sample of 1970 companies from 21 Latin American countries analyzes the existing relationship between the innovation, Information Communication Technology (ICT) and the quality of the small and medium enterprises of 21 Latin American countries. The results obtained show, on one side, that the innovation has a significant positive effect on the quality of the companies and, on the other side, the information Communication Technology also have a significant positive effect on the quality of the small and medium enterprises (SMEs).

Key words: innovation; information communication technology; quality; small and medium-sized enterprises (SMEs)

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1. Introduction

Innovation today is an elemental business strategy for most of the businesses, and various researchers and academics commonly define it as the adoption of new concepts or behaviors in organizations (Shwu-Ing & Chiao-Ling, 2011). Also, the innovation can be considered as the development for the creation of new products, new services, new business management technologies (Shwu-Ing & Chiao-Ling, 2011), which can generate significant positive effects on both the performance of organizations (Damanpour & Evan, 1984; Zahra, Belardino & Boxx, 1988; Khan & Manopichetwattana, 1998), and in improving the business environment to allow the survival and growth of enterprises (Bir, Schacht & Kaufmann, 1988).

Similarly, in most of the current literature in the field of business and management science, innovation and business strategy may include innovation in products, processes, marketing and management systems (Shwu-Ing

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& Chiao-Ling, 2011), which can result in the creation of new products or services, new production methods, new markets, new sources of supply or distribution and new systems of organization (Johannessen, Olsen & Lumpkin, 2001). Also, innovation in the organization is an essential element that usually has a strong influence on the quality of both products and services and new styles of leadership, organizational culture and management commitment that can generate positive impact on the behavior of employees (Belassi & Fadlalla, 1998; Hoff & Weenen, 2004; Jaramillo, Mulki & Marshall, 2005).

On the other hand, the use of Information and Communication Technology (ICT) on the organizations, mainly in the small and medium-sized enterprises (SMEs), facilitates the development and implementation of quality activities both inside and outside companies (Siu, Lai, Keshwar & Teeroovengadum, 2011). Therefore, there are different published jobs in the actual literature that have provided empirical evidence that proves that there is a significant positive close relation between the use of the ICT and the quality, as per example the studies made for Ang, Davies and Finlay (2000); Dewhurst, Martinez-Lorente and Sanchez Rodriguez (2003); Victor, Mjema and Mwinuka (2005); and Siu et al. (2011).

Likewise, in a recent study done by Wai, Seebaluck and Teeroovengadum (2009) they came to the conclusion that the use and implementation of the ICT in the companies, has a significant positive impact in the quality of the activities that the organization performs. The researchers also concluded in the same study that the firms that had an ISO 9001:2000 certification were doing a more efficient use of the ICT, therefore, achieved a more substantial impact on the quality of the activities of the organization, than those companies that did not have an ISO 9001:2000 certification.

In this sense, there is a need of doing more studies that will allow us to analyze in detail the existing relationship between the ICT and the quality in the organizations, especially in the small and medium-sized enterprises (SMEs), in the service firms as well as the national and international manufacturing industry (Siu et al., 2011). Therefore, the main contribution of this paper is the analysis of the existing research between innovation, ICT and quality of the services and manufacturing SMEs in 21 countries of Latin America, using a sample of 1983 firms. The rest of the paper is organized as follows: In the second section the theoretical framework and the previous empirical studies are reviewed; in the third section there is an explanation of the methodology, the sample and the variables used; in the fourth section there is an analysis of the results obtained and; in the fifth section there is a summary of the main findings in the conclusions.

2. Literature Review

The development of the theoretical model describes the existing relation between innovation, ICT and quality of the SMEs. In this sense, in the following sections we will try to clarify the different components of the model, in order to sustain the approaches and results obtained.

2.1 Innovation and Quality

The actual literature considers that the innovation is an essential component in the design and implementation of business strategies, and can be considered as the application of new ideas to develop or to modify products, services, management systems and processes (Robbins, 1996), or it can also be considered as any form or different method of doing things (Porter, 1990). Therefore, the organizations, mainly the small and medium Enterprises (SMEs), have to continuously perform innovation activities to maintain and increase their competitive advantages (Wernerfelt, 1984; Berry & Parasuraman, 1991).

Meanwhile, Glynn (1996) and Carter (2002) considered that the innovation activities can be the result of new investigations and development activities, of new approaches in the production and marketing and, eventually in the new marketing systems, in which innovation can also be considered as the materialization process of a new idea, different forms of production or to do things easier (Shwu-Ing & Chiao-Ling, 2011). Similarly, innovation can also be considered as a process of implementing new methods, products or services (Thompson, 1965), that commonly include the generation of new concepts, the evaluation and implementation (Zaltman, Duncan & Holbek, 1973), and it can provide a higher level of quality and low costs in all the organizations activities (Shwu-Ing & Chiao-Ling, 2011).

Freeman (1997) additionally considered that the innovation is the effort that the firms do through the use of technology and the information systems to develop, produce and commercialize new products that require the industry, the clients and the consumers. Tushman and Nadler (1986) came to the conclusion that the innovation can be conceived as the creation of new products, services or production processes. Meanwhile, Frankle (1990) concluded in his study that the innovation is the modification or the invention of ideas that allow continuously improving and developing the products and services demanded by customers and consumers. Finally, Damanpour and Gopalakrishnan (1998) defined innovation as the process by which new concepts, methods, equipment or products in the organization can be developed.

In the same way, Haner (2002) considered that the innovation is closely related to quality, which is usually added to all outcomes of innovation and includes more on the quality of products and services, the quality of the current operating processes and quality management systems in all activities undertaken by the organization. Therefore, the quantity indicates the efforts of enterprises, especially, SMEs, to adapt and implement innovation activities through the creation of new products, processes and management systems, and that innovation can also satisfy the requirements and needs of the clients, customers, employees, and suppliers (Shwu-Ing & Chiao-Ling, 2011).

On one hand, the relationship between innovation and quality can also be found in both the goals and the results of the activities of the organization, such as the results of new products research development, the increase in value supply chain and the modernization of systems and working methods are some of the most important areas in which are more commonly performed innovation activities in (Shwu-Ing & Chiao-Ling, 2011). Therefore, Ahmed and Zairi (2000) considered that the relationship between innovation and quality is expressed in:

(1) The quality of the products and/or services: Increase of the value perceived by customers, reducing costs, stability in the new designs, a higher return on investment on new products, and improved product performance.

(2) Quality in the operation process: delivery time reduction, higher productivity, staff effectiveness in product development, customer greater control and flexibility of the company.

(3) Quality management systems: employee training, better understanding of the needs of customers, higher sales of innovative products, the highest ratio in the number of patents, and increase the success of innovations.

On the other hand, many companies have increased their profit margin and their participation in the market through the adoption and implementation of innovation, which has resulted to be a strategy that is widely used as an important resource to obtain greatest competitive advantages (Prajogo & Sohal, 2006). Therefore, many researchers, academic and professionals have considered that to better understand success accomplished by a very important number of companies, is necessary to analyze the existing relationship between the innovation and the quality (Keogh & Bower, 1997). Beltz (1993, 2003) also considered that the businesses can achieve better efficiency and generate differentiated services that meet the expectations with the clients, if they innovate their

management system, since innovation is an essential element that allows an increment on the quality level of the products and services (Lyu & Chen, 2005).

In this sense, innovation management systems (as the organizational structure innovation and the staff management skills), and the technological innovation (as the innovation in products, services, production processes and marketing), are equally important as well because both have multiple effects on quality and they also generate a higher level of quality in the organization´s activities (Damanpour & Evan, 1984). Also, Trist (1981) had previously recommended to apply to the companies, especially SMEs, at the same time the innovation in the management systems and the technological innovation, because this not only allows a balance between the internal technical systems and the social structure, but it could also generate a higher level effect of quality in the organization.

Based on the previous statements, at the present time the following can be expressed:

H1: The innovation has a significant positive effect on the quality

2.2 Information Communication Technology and Quality

A lot has been written in the literature about the use and the application of the ICT, as a fundamental factor that allows a significant increment of the organizational management (Zadrozny & Ferrazzi, 1992; Berkley & Gupta, 1994; Cortada, 1995). However, it has also been discussed in literature about the existing issues between the ICT and the possible quality success, as is the case of some research studies done by Sobkowiak and LeBleu (1996) and Pearson and Hagmann (1996). For that reason, in the sense of establishing with more clarity the relationship between ICT and quality, other studies have been oriented to the application of the ICT in many aspects of the quality, providing significant positive results (Miller, 1996; Aiken, Hasan & Vanjani, 1996; Goodman & Darr, 1996; Khalil, 1996; Kaplan, 1996; Kock & McQueen, 1997; Counsell, 1997; Ang, Davis & Finlay, 2000).

In the same way, with the exception of some studies, most of the papers published in the literature linking ICT and quality have been descriptive, and have only presented the results of how the use of ICT increases the level of quality (Ang et al., 2000). For example, Hughes (1994) used in his study a qualitative methodology case to analyze the existing relationship between the ICT and the total quality management system, in the administrative operations and the four superior educational business institutions, finding that the use of ICT in the organizations, will facilitate the quality management system, and for a total quality management will require significant changes in organizational culture and a commitment from senior management.

However, the study by Hughes (1994) does not clearly specify how and when to use of ICT to achieve a significant positive impact on the total quality management of the organization, this researcher identified only one of the key success factors that determine a positive impact of total quality management on corporate performance, but did not specify how ICT should be used to increase the level of total quality management of the organization, leaving a gap in the relationship between the two constructs (Cho, 1994).

In order to provide empirical evidence and contribute to the discussion of the relationship between ICTs and quality, Rogers, Daugherty, and Ellinger (1996) in his paper analyzed the relationship between the two constructs in the storage industry, finding a close relationship between ICT and the quality of performance of the organizations, but the relationship between ICT and quality management of businesses was not analyzed. However, there are other studies in the literature that have a little more in depth analysis of the relationship between ICT and quality management, such as Forza (1995a) who analyzed more fully in their work research the relationship between the two constructs.

Using a new theoretical model and associating it with new measurement variables, Forza (1995b) only analyzed

the use and application of ICT in the quality aspects of insurance from various insurance companies, but did not investigate in more detail the relationship between management practices quality and application of ICT. For this reason, Forza (1995a, b) concluded in his two studies that for a mayor contribution in the relationship between these two variables, in future research should implement and case studies to test models and hypotheses through the development of more appropriate measures concerning both the use of ICT and the quality management.

In this sense, in the literature is very common to find different studies that analyze the impact of ICT in the organizations (Ang et al., 2000), others that analyze how ICTs can make essential changes allow a significant improve on the quality management labor (Straub & Wetherbe, 1989; Scott-Morton, 1994). However, many of this studies do not explain in detail the management practices considered, even when many of them have used measurements of previously developed ICT (Bailey & Pearson, 1983; Mahmood & Mann, 1993; Sethi & King, 1994). It is necessary today to use other latest measurements of ICT in order to analyze in more detail the relationship with quality management (Kanji & Asher, 1993; Mathieson & Wharton, 1993; Wilcox, Dale, Boaden & McQuarter, 1996).

Recently in the literature several researchers and academics have concluded that the application of ICT in various areas of the organization generates growth and expansion of quality (Siu et al., 2011). A possible explanation of this conclusion can be found in the study of Mensching and Adams (1998), who considered that a significant profit increase in all kinds of ICT in businesses is one of the most important factors that allow a significant increase in the quality of the whole organization. Similarly, in a study presented earlier by Murray (1991), this researcher concluded that many investigators and academics were increasingly looking ICTs both for measurement and to understand and improve the quality of organizations.

In a recent study Victor, Mjema and Mwinuka (2005) analyzed in detail the effects of ICT in quality management, finding that the use and implementation of ICT in quality management contributes significantly in obtaining quality awards or recognition, improving the quality of products and services and in reducing the costs associated with quality. However, the use of ICT in the quality management process can also affect the results in the improvement of operational performance measures of companies, such as the reduction of production costs, speed in deliveries, flexibility and time reduction in product cycles (Sanchez-Rodriguez Dewhurst & Martinez-Lorente, 2006).

Meanwhile, Dewhurst, Martinez-Lorente and Sanchez-Rodriguez (2003) concluded in their study that the use of ICT can significantly increase the quality management of the firms, and they felt that the ICT directly support management quality in terms of improving relationships with customers and suppliers, to increase process control, facilitation of team work, facilitate information flows between departments, to improve design processes and skills implementation of preventive maintenance, measurement of quality costs, and to improve decision-making processes in the quality departments of organizations.

Based on the arguments presented previously, we can now present the following hypothesis:

H2: The ICTs have significant positive effects on quality

3. Methodology

This paper includes an extensive review of the work of different authors on the subject in question and also the analysis and interpretation of the answers of the 1970 SMEs surveyed in 21 Latin American countries in 2009. This last was organized in three parts: one part refers to the *Innovation Activities* that SME's have realized in the

last two years; the second part refers to the Innovation and Communication *Technologies* and the changes in the management system; and the other, has to do with the *changes in the quality management systems.*

3.1 Variables

3.1.1 Dependent Variable

For the quality measurement, three questions were used that were measured with a Likert scale of five points, with 1 = strongly disagree to 5 = strongly agree as limits, and were adapted for Garcia (2007). The Table 1 shows in more detail the questions used to measure the quality.

Table 1 Questions Used to Measure the Quality

Compared to your key competitors, your company…	Total Disagree			Total Agree	
Provides higher quality products.	1	2	3	4	5
It has internal processes more efficient.	1	2	3	4	5
Has more satisfied customers	1	2	3	4	5

3.1.2 Independent and Control Variables

To measure innovation activities of the firms, managers from the 1970 Iberoamerican SMEs surveyed asked if the organization had made innovations in the two years prior to the application of the survey (1 = Yes and 0 = No), in products/services, processes and management systems, and for the companies that answered that they had done innovation activities, they were asked to evaluate the degree of importance of these innovations (1 = Unimportant a 5 = Very important, as the limits), since the subjective approach to innovation perceived by the manager is the most appropriate method for SMEs (Hughes, 2001; Garcia, Martinez, Maldonado et al., 2009). Table 2 shows the questions used on the survey to measure the innovation activities.

Table 2 Questions Used to Measure Innovation

Have you made any change or improvement to your products, processes or management systems in the last 2 years? If so, indicate the degree of importance of these changes for your business?			Degree of Importance				
			Unimportant				Very Important
Products/services							
- Changes or improvements in products/ existing services	No □	Yes □	1	2	3	4	5
- Commercialization new products/services	No □	Yes □	1	2	3	4	5
Processes							
- Changes or improvements in the production processes	No □	Yes □	1	2	3	4	5
- Acquisition of new capital equipment	No □	Yes □	1	2	3	4	5
Management System							
- Direction and Management	No □	Yes □	1	2	3	4	5
- Purchasing and Procurement	No □	Yes □	1	2	3	4	5
- Commercial/Sales	No □	Yes □	1	2	3	4	5

On the other hand, to measure the use of ICT managers and/or owners of 1970 Iberoamerican SMEs were surveyed, and asked if their business had available the following: (1 =Yes & 0 = No)

(1) Do your firm have E-mail?

(2) Do your firm have a WEB page?

(3) Do your firm purchase on line?

(4) Do your firm use electronic banking?

(5) Do your firm do marketing using internet?

(6) Do your firm have corporative internet?

Taking in consideration the answers provided ICT variable came up through the sum of all the affirmative questions, having a nominal variable with a value from 0 to 6. This way of configuring the variable can be seen in Garcia (2007) and Garcia, Martinez, Maldonado et al. (2009).

Size. This variable was measured through the average number of employees of the year 2009.

Age. Measure through the number of years passed since the constitution or the beginning of the activity to the survey application date.

4. Results

To verify the existing relationship between innovation, ICT and the SME quality and prove the research hypotheses proposed, a linear regression analysis was performed using the MCO through the following models:

Model 1: $Quality_i = b_0 + b_1 \cdot Innovation_i + b_2\ Size + b_3\ Age + \varepsilon_i$

Model 2: $Quality_i = b_0 + b_1 \cdot ICT_i + b_2\ Size + b_3\ Age + \varepsilon_i$

Where, $Quality_i$ corresponds to the average of the three variables used for the measurement. $Innovation_i$ indicates the innovation importance of products/services, processes and management system. ICT_i indicate the degree of utilization of the firm. *Size*, average number of employees, and Age, years of existing of the company. We estimated a model for the innovation variable and another model for the ICTs variable. We observed in both models that the independent variables have a variance inflation factor (VIF) close to 1, therefore, we ruled out the presence of multicollineality.

Table 3 Relationship between Innovation and Quality (n = 1970)

Variables	Quality
Innovation	0.190**
	(3.948)
Size	0.128
	(1.198)
Age	0.091
	(0.914)
Higher VIF	1.058
F Value	5.596**
R^2 Adjusted	0.092

Note: Below each coefficient standardized brackets, statistical value t-student; *= $p \leq 0.1$; **= $p \leq 0.05$; ***= $p \leq 0.01$.

Table 3 shows that a greater use of innovation within SMEs has a positive and very significant quality (standardized coefficient = 0.190 and $p < 0.05$) confirming the first hypothesis. However, the size and the age don't affect the quality of SMEs, for not being statistically significant variables. The validity of the model is tested through the resulting adjusted R^2 of 0.092 and an F value of 5.596 ($p < 0.05$). The independent variables are the variance inflation factor (VIF) close to 1 (1.058), so we discarded the presence of multicollineality.

Table 4 shows that an increased use of ICT within organizations positively influences very significantly in the innovative activity of SMEs (standardized coefficient = 0.135 and $p < 0.05$) which is confirmed by the second working hypothesis. However, the size and the age don´t affect the degree of innovation of SMEs, to not be statistically significant variables. The validity of the model is tested through the resulting adjusted R^2 of 0.084 and an F value of 4647 ($p < 0.05$). The independent variables are the variance inflation factor (VIF) close to 1 (1.055), so we discarded the presence of multicollineality.

Table 4 Relationship between ICT and Quality (n = 1970)

Variables	Quality
ICT	0.135**
	(3.596)
Size	0.104
	(1.430)
Age	0.096
	(1.042)
Highest VIF	1.055
F Value	4.647**
R^2 Adjusted	0.084

Note: Below each standardized coefficient, in parentheses, the value of statistical t-student; *= $p \leq 0.1$; **= $p \leq 0.05$; ***= $p \leq 0.01$.

5. Conclusion and Discussion

The results obtained in this paper support the conclusion that the innovation has a close relationship and a significant positive impact on the quality of the activities of the organization, so if SMEs managers want to improve the quality level of the company, then you will need to initially adopt and implement innovation activities, because it will allow them to significantly increase their level of quality. Also, we can conclude that the ICT have a close relationship and a significant positive effect on the quality of the activities of the SMEs, leading to think that increasing the quality level of the organization, the use and adoption of ICT in all functional areas of the company will be essential to achieve the goals and objectives in the short term.

In this sense, the innovation in products and services, processes and management systems play an essential role in the organizations, not only as a business strategy, but also as a basic element that facilitates and affects the quality improvement of products, processes, and management systems. For this reason, managers of SMEs should include in the innovation, tasks as part of daily activities, trying as far as the organization's possibilities to implement these activities on the companies' functional areas and not in isolation, as this could not have the expected effects on the quality of business activities.

In the same way, the adoption and implementation of ICT generate different benefits in the organization, improving the quality of the activities carried out by SMEs, which means that managers have to pay more attention to the use of ICT that owns the business. For this reason, SMEs managers should at all times develop and implement various training courses for the staff as the ICT will allow for staff to make more efficient use of information technology, reduce time and costs in the various activities of the business, implement programs of promotion and advertising through web design, banking, and financial activities and implement various marketing activities that may impact an improvement in the level of the quality of products and services provided by the organization.

Additionally, The results obtained can be very useful for the government authorities of the three levels of government, as this information can be used for the design and implementation of policies and programs to support SMEs in Latin America, aimed at adopting and implementing activities innovation, the use of ICT and the increased level of quality that benefit businesses. Furthermore, this information can also be used to design training programs for both managers and employees of SMEs, as to motivate the use and implementation of innovation activities and ICT both in the various functional areas of the company, so that they understand that the use of this technological tools they could facilitate the performance of their work and could significantly improve the quality level of the organization.

Similarly, this information can also be of great importance for both the leaders of the various chambers and business associations, and entrepreneurs themselves, since they can obtain valuable information about the situation that the different business sectors in Latin America, on the use and implementation of innovative activities and ICT, which could facilitate the design and implementation of business strategies aimed at the adoption of innovation and ICT in the organization, to adapt more quickly to the requirements that demand an increasingly competitive and globalized market.

On the other hand, this study presents a few limitations that need to be explained. First, there is a limitation of the sample, since it only considered companies with 5 to 520 employees from 21 countries in Latin America and only 100 companies in each country, which was left out of the study most micro-enterprises (1 to 4 employees), which together represent for a Little over 50% of the total population, which would be necessary for future studies to consider both smaller companies and SMEs from other states to see the behavior of these variables.

Second, there is the limitation of obtaining information since on the survey it was only considered a part of the total information of innovation, ICT and quality. Also, it was very difficult to obtain information, because most of the companies considered that the information required was confidential and they were not willing to answer surveys, so the data provided by the managers not necessarily reflect the real activities of innovation, the use of ICT and the quality of the organization.

Last, another limitation is that the instrument to measure innovation, ICT and quality, only was used by SMEs managers, so it is assumed that they have a lot of knowledge about the three variables used in this study. It will be appropriate that in future studies this survey was applied to both employees and the organization's customers, to gather information from another perspective and correlate it with the information provided by the managers.

Finally, on the scale of innovation activities only three dimensions were considered (innovation in products/services, innovation in processes, and innovation in management systems), to measure ICT only six questions were considered and to measure quality only three questions were considered, so it would be very important in future studies to consider other quantitative measures. Therefore, it is questionable right now what would happen to the quality of the organization if another quantitative variable was considered? Or what about innovation and ICTs if they consider other items for measurement? These and other questions that may come off this empirical study can be answered in future studies.

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