The Effect of Information and Communication Technology in Innovation Level: The Panama SMEs Case

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Abstract

The information and Communication technology play an essential role in the development in the level of innovation in Enterprise, not only large corporations, but also micro, small and medium-sized enterprises, they also facilitate the growth and development of the organizations in a highly, globalized and competitive world, as the one that characterizes the current century. Therefore, the essential objective of this research work is to analyze existing effects between information and communication technologies in the level of innovation in small and medium-sized enterprises, using a sample of 615 micro, small and medium-sized enterprises in Panama. The results obtained show that information and communication technologies have significant positive effects in innovation activities of companies.

Keywords: Information and communication technology, innovation, SMEs

1. Introduction

The present century is characterized, among other factors, by an uncertainty in the business in which the market increasingly globalized and highly competitive, in the participating firms, is driving organizations to make significant changes in their strategies to bring them into line with the requirements of the new competitive environment (Moshin, Bashir & Latif, 2013). Therefore, firms particularly small and medium-sized enterprises (SMEs), have a strong pressure to maintain or improve their competitive advantage in an environment increasingly turbulent and various organizations have considered innovation as an essential strategy, which can provide the competitive advantages that require not only to maintain its current competitive position, but also to survive (Nonaka & Takeuchi, 1995).

Similarly, the information and communication technology plays an important role in the new milllenium companies, since its adoption and implementation in business activities generates, on one hand, a higher level of process innovation (Quinn, Baruch & Zien, 1999) and, on the other hand, the applications of information technology or software that handle specialized companies such as the resource planning (ERP) system for decision support (DSS), relationship management (CRM), enable a higher level of innovation and knowledge in the organization (Moshin *et al.*, 2013). In this sense, various researchers, academics and professionals of business and computer science, consider that the use and management of information and communication technology by managers and/or owners of SMEs not only provide organizations greater level of competition, but also decrease the risk and uncertainty about the business environment and facilitate the implementation of strategic planning (Dibrell & Miller, 2002; Gibson & O´Connor, 2003).

In addition, for SMEs to achieve a higher level of innovation, all activities related to innovation made by companies, should have a basic support of information technology and communication (Frishammar & cohort; 2005 Dibrell, Davis & Craig, 2008). Also, Johannessen (1994) concluded in their study that the information and communication technology can have significant positive effects on innovation activities if they are used efficiently and effectively, as traditional activities conducted in the organization can be changed to incorporate information technology and communication. Meanwhile, Bharadwaj (2000) also concluded in their study that the companies that made a major investment in information technology and communication, achieved a higher level of competition and innovation that companies that did not invest in it.

In this context, the main contribution of this empirical study is the analysis of existing effects between information technology and communication, and the level of innovation in small and medium enterprises in a developing country, such as Panama. The rest of the paper is organized by the following order, in the second section we review the theoretical framework, the few empirical studies conducted previously and research hypotheses posed, the third section presents the methodology, sample and variables used, the fourth section discusses the results and finally, in the fifth section the major findings and discussion of the empirical study are presented.

2. Literature Review

The concept of information and communication technology has not been extensively analyzed and discussed in the literature by either researchers, academics or professionals in the business area, although it is an essential element in the effectiveness of work in operational and management areas of enterprises, particularly SMEs areas (Moshin *et al.*, 2013). Also, one of the many elements that characterize the present century is the information and communication technology, which plays a fundamental role in establishing the basis for the adoption and implementation of the innovation activities that the organizations need to improve management and production methods, which will allow them to survive in a highly globalized and competitive market (Moshin *et al.*, 2013).

In this sense, according to Frishammar and cohort (2005) usually the ideas that become innovations are implemented by initiatives of the information and communication technology, commonly, the results of this improve significantly the innovation of new products and processes, which translates in a customer´s loyalty promotion and stimulate a demand for other products of the organization. Also, Karadal and Saygin (2011) concluded in their study that the adoption and implementation of the information and communication technology, have significant positive effects on the development of new products and therefore, innovation, which allows companies to make better use of information and, communication technology for the generation of new ideas and implementing these in production processes for the production of products demanded by customers and consumers of the organization.

Meanwhile, Dibrell *et al.* (2008) considered in their study that the extent to which firms want to maximize innovation activities performed daily, should in the first instance, adopt and implement the information and communication technology and, on appeal, align initiatives in information and communication technology with all activities of the innovation made by organizations. Therefore, there is sufficient in the current literature arguments demonstrating the existence of empirical evidence of the relationship between information and communication technology and innovation, in addition to the two complementary variables, as an efficient and effective adoption of information and communication technology skills that can increase business for the creation and implementation of innovation activities (Moshin *et al.*, 2013).

Similarly, Ismail Mamat (2012) concluded in their study that both information and communication technology as innovation, have a high relevance for researchers, academics, business administration professionals, managers and government authorities policymakers and business programs. It is also very common to find in the literature both theoretical and empirical studies, which considered that the adoption and implementation of information technologies and communication, provide organizations an opportunity to effectively and efficiently improve their innovation activities, allowing them to acquire or increase their competitive advantage (Benjamin, Rockart, Scott-Marton & Wyman, 1984; Porter & Miller, 1985; Earl, 1989; Thong & Yap, 1995).

Currently, a significant portion of the companies in different countries, mainly SMEs, are devoting a substantial portion of its financial resources in the acquisition or renewal of information and communication technologies, and are adopting as a business strategy and as a routine within the organization activity. (Ismail & Mamat, 2012).

Also, these businesses have regularly taken the information technology and communication for use in the management of customer relationships, improve the production process, managing the supply chain, innovation and other essential activities of organizations (Barua & Mukhopadhyay, 2000; Agarwal & Sambamurthy, 2002; Tsou & Chen, 2007), in addition to substantially increase and enhance their competitive capabilities (Sambamurthy, Bharadwaj & Grover, 2003).

In this context, several researchers, academics and practitioners of business and computer science, have considered the information and communication technology an essential element in the development of innovation activities (Corso & Paolucci, 2001; Xu Sharma & Hackney, 2005), so the companies that have adopted and implemented in their daily activities, have achieved better results and a higher level of innovation of its products and services (Ismail & Mamat, 2012). Also, many of innovation activities undertaken by organizations generally involve the development of new services, expansion of existing services or process improvement services that are given to their customers and consumers, so the success that SMEs can achieve depend heavily on innovation and implementation of new services demanded by the market (Berry, Shankar, Parish, Cadwallader & Dotzel, 2006).

Thus, the adoption and implementation of good practices in innovation by companies can significantly increase the competitive advantage of SMEs (Bharadwaj, Varadarajan & Fahy, 1993; Afuah, 1998). However, there are few papers published in the literature relating the information and communication technology innovation of both products and services, so it is imperative that both researchers and scholars and practitioners of business and computer science work in these topics (Preissl, 1999). Therefore, in order to provide empirical evidence and understand the adoption of information and communication technologies by organizations and their impact on innovation activities, Galbraith (1973) had already considered, since the early seventies, that the adoption of information and communication technologies generate significant changes in all activities related to innovation.

Additionally, the theoretical and empirical literature provides evidence that the adoption of information and communication technology significantly increases the response of organizations to the demands posed by both the market and consumers in less time in delivery (Tiannilä & Vepsäläinen, 1995). Externally, with the use of information and communication technology companies not only improve delivery times of products and services, but these technologies also generate various advantages both in the design and modification of new products or services provided to its customers and consumers (Avlonitis, Papastathopoulou & Gounaris, 2001).

Internally, information and communication technology can significantly increase both the growth capabilities of the products and services, and the efficiency in the management of time designing them, reducing the number of prototypes, reducing costs and improving the quality of innovations, plus it also helps improve communication with partners and suppliers (Ozer, 2000). Thus, considering the information previously presented, in these moments the following hypothesis can be propose:

H1: To greater adoption of information and communication technologies, the greater the level of innovation.

3. Methodology

To test the hypothesis of this research, an empirical study was conducted in 615 micro, small and medium enterprises in Panama, taking into consideration the business directory of the General Comptrollership of the Republic, which in the month of December 2011 recorded a Total of 49,775 companies of all sizes and sectors. For purposes of this study only the companies that had between 3 and 250 employees to date, were considered reducing the business directory to 47,654. Therefore, the sample was selected at random with a confidence level of 96% and a sampling error of ± 4%, leaving a total of 648 companies, applying the survey through a personal interview during the months of June to December 2012 to managers and / or owners of the selected companies, of which a total of 615 were validated, obtaining a response rate of 95%.

3.1. Variables

3.1.1. Innovation

Generally, in literature the concept of innovation includes both technological innovation and innovation in management methods (AECA, 1995; 2005), given that technological innovation refers to changes in the typology of the products and the introduction of new production processes (Freeman, 1974), and innovation in management systems is obtained through the changes in the organizational structure of the Company and in the administrative process.

Therefore, to measure innovation managers were requested to provide information to know if the company had made innovations in the last two years (1=yes and 0=No) in products/services (changes or improvements in products-existing services and marketing of new products-services), processes (changes or improvements in product processes, services and acquisition of new equipment) and systems management (leadership and management; purchasing and supplies; commercial-sales).

Therefore, for those companies that have made innovations they were asked to evaluate their degree of importance (1 = least important to 5 = very important), because the subjective approach to perception of innovation, on the manager´s side, is the most appropriate method for the case of SMES (Hughes, 2001; Garcia *et al.*, 2009). Also, based on these responses obtained, the variable General innovation was created through the arithmetic mean of the seven questions that is measured in the scale of innovation, thus taking a scalar variable with a value of 1 to 5.

3.1.2. Information and Communication Technology

To measure the degree of utilization of information and communication technologies the managers of SMEs surveyed, were requested to indicate whether their company had the following infrastructure (Yes = 1 and 0 = No):

1. Email Address?
2. Web Page?
3. Shopping and/or electronic sales using the Internet?
4. Do you use online banking?
5. Do you do marketing using Internet?
6. Do You Have Corporate Internet?

From the responses obtained, the variable information and communication technologies was created through the sum of the affirmative questions, thereby having a nominal variable with a value of 0 to 6. This way to configure the variable can be seen in García (2005) and Garcia, Martinez, Maldonado *et al.* (2009).

Size. This variable was measured by the average number of employees of companies in 2011.
Age. Measured by the number of years since the constitution or the start of business activity.

To assess the reliability and validity of entrepreneurship orientation one confirmatory factor analysis (CFA) was applied, using the maximum likelihood method with EQS 6.1 (Bentler, 2005, Brown, 2006; Byrne, 2006) software. The reliability of the theoretical model was evaluated using Cronbach's alpha and composite reliability index (IFC) (Bagozzi & Yi, 1988). In addition, we took into account the robust statistical which provide better statistical adjustment of the data proposed by Satorra and Bentler (1988). The results of the AFC are presented in Table 1 and show that the scale for measuring innovation has a good fit ($S\text{-}BX^2$ = 18.105, df = 11, p = 0.000, NFI = 0.994, NNFI = 0.995, CFI = 0.998, and RMSEA = 0.032).

In addition, all items related factors are significant ($p < 0.01$), the size of all standardized factor loadings exceed the value of 0.60 (Bagozzi & Yi, 1988), Cronbach's alpha and the IFC have a higher value 0.70 and extracted variance index (IVE) has a value higher than 0.50 (Fornell & Larker, 1981), indicating the existence of reliability and validity convergent, thereby justifying the reliability of the measurement scale of the innovation (Nunally & Bernstein, 1994, Hair *et al.*, 1995.).

In regards to the discriminant validity of the theoretical model, the evidence is provided in two ways that can be seen in Table 2. The first test of confidence interval proposed by Anderson and Gerbing (1988), which establishes that with a range of 95% of confidentiality none of the individual elements of the latent factors of the correlation matrix contains the value of 1.0. Secondly, there is the test of the proposed variance extracted by Fornell and Larcker (1981), which indicates that the variance extracted between each pair of constructs is lower than their corresponding IVE. Therefore, according to the results obtained in both test it can be concluded that there is sufficient evidence of discriminant validity of the theoretical model

4. Results

To check the influence of information and communication technologies (TICs) in the level of innovation in the SMEs, we used a linear regression by MCO through the following model:

$Innovation_i = b_0 + b_1 \cdot TICs_i + b_2\ Size + b_3\ Age + \varepsilon_i$

The results of the relationship between information and communication technologies and innovation are presented in the following table.

The results show that the increased use of information and communication technologies within organizations has a positive and very significant innovation in SMEs in Panama (standardized coefficient = 0.326 and $p < 0.01$) as the working hypothesis is confirmed. However, the size and age did not affect the degree of innovation of SMEs, to not be statistically significant variables. The validity of the model is tested through the adjusted R^2 resulting from 0.104 and F value of 24.636 ($p < 0.01$). The independent variables have a factor of the variance inflation close to 1 (VIF), so that rules out the presence of multicollinearity.

Similarly, the above table shows that a greater use of information and communication technologies in Panama SMEs influences positively and significantly on product innovation (standardized coefficient = 0.301 and $p < 0.01$), but the size and age do not affect the level of innovation in products, as they did not prove the significant variables. Also, the validity of the model is contrasted through the adjusted R^2 that has a value of 0.086 and an F value of 20.173 ($p < 0.01$). The independent variables have a factor in the inflation of the variance (VIF) close to 1 (1.038), so there is no multicollinearity.

In terms of innovation processes and innovation management systems of companies, is also observed that the increased use of information and communication technologies in SMEs Panamanian positive and significant influence on these types of innovation, presenting, in both cases a standardized coefficient = 0.262 and $p < 0.01$. However, the size and age did not reflect an effect on process innovation or management systems to not present these variables statistically significant results. The validity of the model is compared with the adjusted R^2 which has a value of 0.070 and an F value of 16.490 ($p < 0.01$). For the VIF value is close to 1 (1.038), there is no multicollinearity in the independent variables.

5. Conclusion and Discussion

According to the results presented, it is concluded that the adoption of information technologies and communication, on the part of the SMEs in Panama, contribute to a higher level of innovation of the same general results which are audited also when they are analyzed in this investigation, the three activities of innovation: innovation in products, innovation in processes and innovation in the company management systems. On the other hand, it is proven that the size and age of the company do not show effects on the degree of innovation of the SMEs in Panama, in failing to submit these variables statistically significant results.

We conclude, therefore, that the development of innovation in operational management and Panamanian SMEs areas is essential to survive in today's highly globalized and competitive market, it is essential the required investment for significant improvement and to increase the use of information and communication technology within the organization. The managers and/or owners of the SMEs of Panama must improve and increase the use of the information and communication technologies, in search of major levels of innovation and to manage this form to improve the levels of competitiveness of the company and to diminish the risks and the uncertainty that generates the environment of the business today.

It is necessary that managers of SMEs learn more about the real value and importance of the use and application of efficient and effective communication and information technologies in their companies, because the results of the research show that the most widely use of information and communication technologies tools is the email (83.1%); and electronic banking (64.2%), while the website, purchases/sales by Internet, corporate intranet and marketing online are used by less than half of the companies. The progress of information and communication technologies by Panamanian SMEs, in relation to the average of technologies used stands at half of technologies (3.1%); 14% of the companies develop the six technologies and 13.3% of them do not use any technology.

The use of information and communication technologies by Panamanian SMEs face major obstacles such as the cost of technology, uncertainty of benefits and the business impact, lack of knowledge, reliance on external consultants, the lack of reliability of systems and technological obsolescence.

Public policies for SMEs should consider actions to support them. It is necessary that training programs for employees, managers and entrepreneurs are set to become aware of the great importance of the use of information and communication technologies and their influence on the degree of innovation of the company.

This research has several limitations that are important to consider at this time. The first one is the use of scales of measurement of information and communication technology and innovation, as the information and communication technologies were measured directly, and innovation was measured through three factors or dimensions, so in future studies it will be important to incorporate other scales to check the results. The second limitation is obtaining information, as it was considered only a small part of the information and communication technologies and innovation obtained through qualitative variables, therefore, in future studies the incorporation of quantitative variables will be needed to confirm whether the same results are obtained.

The third limitation is the measurement of the qualitative variables of the two scales used, as **six** items were used to measure the information and communication technologies, and seven items to measure the three factors of innovation, so in future studies the use of quantitative items or a larger number of items to measure both constructs is required. The fourth limitation is that surveys are only applied to managers and/or owners of micro, small and medium enterprises, thus the results may be different if applied to a different sample, such as customers and suppliers, so future studies should incorporate them to see if the results are similar.

The fifth and final limitation is related to the companies surveyed, as only the firms from 3-to 250 workers in Panama were surveyed, so in future studies it will be necessary to consider companies that have less than 3 workers to corroborate the data. Finally, it would be desirable in future studies to discuss in more detail, what effect would it have on the innovation of small businesses if a different scale is used to measure the information and communication technologies? What results would be obtained if other factors are used to measure innovation? These and other questions that may arise can be answered in future research.

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Table 1. Internal Consistency and Convergent Validity of the Theoretical Model

Variable	Indicator	Factor Loading	Value t	Cronbach´s Alpha	IFC	IVE
Innovation in Products	IP1 IP2	0.746*** 0.732***	1.000[a] 21.360	0.701	0.706	0.567
Innovation Processes	IR1 IR2	0.808*** 0.653***	1.000[a] 16.087	0.763	0.772	0.504
Innovation Management Systems	IS1 IS2 IS3	0.762*** 0.796*** 0.721***	1.000[a] 26.571 24.085	0.802	0.804	0.578
X^2 (df = 11) = 18.105; p < 0.007; NFI = 0.994; NNFI = 0.995; CFI = 0.998; RMSEA = 0.032						

[a] = Parameter constrained to this value in the identification process

*** = p < 0.01

Tabla 2: Discriminant Validity of the Theoretical Model

Variables	Innovation in Products	Innovation Processes	Innovation Management Systems
Innovation in Products	**0.567**	0.266	0.216
Innovation Processes	0.462 - 0.570	**0.504**	0.243
Innovation Management Systems	0.411 - 0.510	0.441 - 0.545	**0.578**

The diagonal represents the index of variance extracted (IVE), while above the diagonal part of the variance (correlation box) is shown. Below the diagonal, the estimate of the correlation of the factors with a confidence interval of 95% is presented.

Table 3: Information and Communication Technologies and Innovation in SMES

Variables	Innovation Activities			General Innovation
	Innovation in Products	Innovation Processes	Innovation Management Systems	
TICs	0.301*** (7.660)	0.262*** (6.621)	0.262*** (6.621)	0.326*** (8.386)
Size	-0.006 (-0.164)	0.042 (1..056)	0.042 (1.056)	0.012 (0.304)
Age	-0.031 (-0.803)	-0.033 (-0.853)	-0.033 (-0.856)	-0.021 (-0.553)
F R^2 adjusted	20.173*** 0.086	16.490*** 0.070	16.490*** 0.070	24.636*** 0.104
Below each standardized coefficient, in parentheses, the value of statistical t-student*= p ≤ 0.1; **= p ≤ 0.05; ***= p ≤ 0.01 Higher VIF in models: 1.038				