UNDERSTANDING THE RELATION BETWEEN IT COMPETENCE AND THE COMMERCIAL SUCCES OF INNOVATION

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ABSTRACT

In order to improve the commercial success of innovation, many companies have developed strategies that include investing heavily in information technologies. However, certain research works challenge its positive relationship with business performance and suggest that others elements may mediate the link. This paper proposes the commercial success of innovation as a dependent variable of information technology competency. Based on the literature on dynamic capabilities' view we propose that internal and external learning competences play a key role in the relationship between information technology competency and the commercial success of innovation. We used structural equations to test the hypotheses in a sample of 186 companies of the ceramic tile industry. The results suggest that IT competency improve the commercial success of innovation and this relationship is fully mediated by internal and external learning competences.

Key words: Information technology competency, dynamic capability, innovation performance, internal learning competency, external learning competency.

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1. INTRODUCTION

Information Technology (IT) allows us to save time, do a more effective management and improve information, since it facilitates access to key knowledge (Phiri, 1999). Thus, advances in information technology have promoted substantial changes in business settings, especially in business practices by shortening productive cycles, allowing fast technological development and finally originating hyper-competitive surroundings (Segars and Dean, 2000).

Those companies capable of introducing fast changes and adapting to new technologies can develop more competitive advantages than slower and less informed competitors (Barney et al., 2001). However, some studies do not support the positive relation between IT and company performance (Devaraj and Kohli, 2003). An explanation for this may be that IT represents a necessary but insufficient resource to achieve competitive advantages (Tippins and Sohi, 2003). Many researchers on strategic management relate it with other specific components of a firm´s strategy (Rivard et al., 2006), as well as with components derived from the Resource Based View (Lin et al., 2008). The latter states that not only are information technology investment important, but it will also be a key element like organizational learning and internal knowledge.

The concept of "knowledge as resource" suggests that knowledge can be transmitted, combined, and used for value creation (Gran, 1996). Therefore, creation and effective knowledge transfer can contribute towards the development of competitive advantages (Alavi, 2000). Re-configuration of resources is essential, since it provides a dynamic capability to coordinate, expand and explore new knowledge and develop new operational competences (Teece and Pisano, 1994; Ambrosini and Bowman, 2009).

Due to changing environment conditions, firms need to adapt internal knowledge base in order to succeed in changing markets. The capacity to set up knowledge base has been considered by some academic as a dynamic capability (Zollo and Winter, 2002; Marsh and Stock, 2006; Easterby-Smith and Prieto, 2008). Internal learning refers to new knowledge created by a firm´s accumulation of experience using its own resources, whereas external learning refers to new knowledge created and integrated inside the company by interacting with the environment and other firms (Kessler et al., 2000; Chang, 2003; Bapuji and Crossan, 2004).

Knowledge creation and use are associated with innovation, since the latter is related to successful exploitation of new ideas (Amabile et al., 1996). We can consider the commercial success of innovation as an approximation to overall performance, since it has been suggested in the literature that companies with higher innovation performance obtain greater overall performance (Darroch, 2005).

Although previous studies have tested the relationship between IT competency, knowledge or learning and company performance (Tippins and Sohi, 2003, Lin et al., 2008), these have been inconclusive (Powell and Dent-Micalef, 1997, Devraj and Kohli, 2003). In order to deepen the understanding of the above relationship, this study includes a new dependent variable closely linked to business results, the commercial success of innovation. Previous studies consider that innovation performance has a direct effect on a firms' overall performance (Wheelwright and Clark 1992; Renko et al. 2009; Baker and Sinkula 2009).

In addition, some of the studies aimed at explaining the existence of a relationship between IT and innovation, both theoretically (Davenport, 1993, Holsapple and Singh, 2003, Davenport et al., 2008) and empirically (Sabherwal and Sabherwal, 2005) obtained mixed results (Joshi et al., 2010), especially concerning the commercial success of innovation. In this study we suggest two intermediate variables which will help explain the above relationship and allow us to understand why, under certain conditions, investments in IT do not generate higher innovative results. These variables are internal and external learning competences. IT competency will enhance the internal and external learning competency and will be these that affect the commercial success of innovation.

We used structural equations to test the hypotheses in a sample of 186 Italian and Spanish ceramic tile industries. These companies represent 50% of the target goal. The results provide empirical evidence that IT competency is positively related to internal and external learning. Secondly, internal and external learning competences play an important role in determining the effects of information technology in the commercial success of innovation.

In the following sections we review the literature on IT Competency and internal and external learning competences. Next, we present the hypotheses, describe the methodology used in the empirical study, and analyze the main results achieved. The paper concludes with academic and practical implications of this research.

2. CONCEPTUAL BACKGROUND

2.1 Information Technology Competency

Before 1990 much of the literature on IT was based on its potential to alter an entire set of strategic variables and industrial structure, including positions in costs, economies of scale and market power (Clemons, 1986). Subsequently, the literature has been interested in the relationship between IT and specific components of business strategy, including competitive advantage (Mata, Fuerst and Barney, 1995), business performance (Dollinger, 1984, Powell and Dent-Micallef, 1997; Bharadwaj, 2000), organizational learning (Tanriverdi, 2006) and open innovation (Huang , 2011). Similarly IS literature shows that IS may play an important role in enabling firms to develop and leverage some organizational competences (Zhang and Lado, 2001).

Many studies assume that an increased investment in IT will improve the value of IT at the company (Sircar et al., 2000, Thatcher and Oliver, 2001). However, this approach underestimates issues such as equipment obsolescence or rapid decrease in the price of hardware, which causes much of the material that companies own, lost its value quickly. Therefore, in this study we assume a competency approach. We suggest that developing competence through tools and processes used to manage information has reached certain relevance given the significant increase in current market information.

Various authors have provided a definition of the concept "IT competency". For example, Ross et al., (1996) defined it as the ability to control IT-related costs, provide appropriate systems when is needed, and improve business strategy by applying IT. Sambarmurthy and Zmud (1997) and Feeny and Wilcocks (1998), described IT competency as the different assets, skills, knowledge, processes and relationships that enable companies to acquire, deploy and manage IT products and services in order to improve innovations and business strategies. Bharadwaj (2000) understands it as a

firms´ ability to mobilize and deploy IT resources base in combination with others resources and capabilities. We adopted Tippins and Sohi (2003) definition which describes IT competency as a firms´ ability to manage effectively IT in order to promote knowledge flow inside the firm.

The concept is measure as a second-order construct composed of three first-order factors. These factors have a similar level of importance, representing co-specialized resources that provide a measure of firms´ ability to understand and use IT competency tools and processes in order to manage market and customer information.

IT knowledge. As with other specific domains of knowledge, IT knowledge is considered as a subset of the more general conception of knowledge (Capon y Glazer, 1987). Similar to Tippins and Sohi (2003) we conceptualized IT knowledge as the degree to which a company has a body of technical knowledge about objects, such as computer systems.

IT operations. IT operations represent the extent to which a firm utilizes IT to manage market and customer information (Tippins and Sohi, 2003). It comprise activities undertaken in order to achieve a particular task that can be, for example, the production of economics goods and services or the transfer of knowledge to a specific operations (Leonard-Barton, 1995).

IT Objects. IT objects act as "enablers" and are largely responsible for current increases in information production and dissemination (Glazer, 1991). For this study the conceptualization of IT objects represents elements such as computer-based hardware, software, and support personnel (Tippins and Sohi, 2003).

2.2 Organizational learning

According to previous studies, a futures research line related to organizational learning could be the study of how organizational learning is affected by technological developments (Argote, 2011). Within this new trend we can find studies such as the one developed by Antonelli and Ferraris (2011) which suggests that for introducing technological and organizational innovations, it is required the generation of new knowledge.

External learning competency. It refers to firms´ ability to create and integrate new knowledge by means of interaction with the environment and other organizations (Bapuji and Crossan, 2004). That is, the company reconfigures the practices through knowledge transformation. An example can be the combination of current knowledge with new knowledge obtained from technology acquisition and interaction with the environment and other organizations (Ettlie and Pavlou, 2006). The new knowledge acquired from external sources is integrated in the knowledge base of the company and represents an important input for innovation processes (Chang, 2003). This learning will be faster if it is based on accumulated experience and knowledge base available at firm level (Malerba, 1992, Levinthal and March, 1993).

Internal learning competency. It refers to the knowledge created by firms´ own accumulated experience by means of the use of their resources. The internal learning takes place mainly through research and development and implementation of best practices. It is included in company´s knowledge base and plays an important role in the innovation process (Cohen and Levinthal, 1990, Kessler et al.2000)

Our measure of internal and external learning competency is based on a dual learning track approach or double loop, since it involves changing practices, goals and implicit rules at the organization (Argyris and Schön, 1978). The characteristic of this type of learning is that it assumes that workers and middle managers transmit information about their views on if it is necessary to change any of the practices of the company that in turn implies changes on the strategy being implemented.

3. HYPOTHESES

Time represents one of the most important parameter to control in competitive markets. The faster a company develops a product, the higher is its possibility to achieve competitive advantage (Filippini et al., 2004). Therefore, research and development department should apply techniques in order to speed up product development process. The effective use of IT competency within the R&D department can cause a decrease of time for product development (Bullinger et al., 2000). In addition, IT helps to build a collaborative environment, such as electronic newsletters or knowledge-sharing portal. These kind of environments promotes a creative thinking and accelerate the efficiency and effectiveness of innovation processes (Li et al., 2006), affecting positively product innovation.

Competitiveness and survival of companies depends increasingly on its ability to produce innovations continuously (Cohen and Levinthal, 1990). Therefore, since the creation, dissemination and use of knowledge is facilitated by IT (Davenport et al., 2008), an increase on IT use may promote the development of the knowledge capabilities needed to maintenance knowledge management initiatives as well as to enhance innovation performance (Alavi and Leidner, 2001). Considering the above:

H1: IT competency positively affects the commercial success of innovation.

Joshi et al. (2010) suggest that IT helps companies to improve knowledge acquiring capacity by means of the identification of employees with key knowledge for strategic development and application, as well as the use of sophisticated mechanisms for searching, recovering and data structuring. Alavi and Leidner (2001) defined IT as a tool for improving the ability of a company to assimilate knowledge, by creating an organizational memory as repository of knowledge. From organizational learning, companies can accumulate valuable knowledge as a stock and subsequently be available for employees use (Tippins and Sohi, 2003).

IT strengthens company's internal learning (Joshi et al., 2010). In turn, from the RBV, the ability to learn is defined as the firm's ability to develop or acquire new resources and knowledge-based skills useful for new products development (Hull and Covin, 2010).Specifically, we define internal learning as firm´s members acquisition of new information and knowledge by interacting with other units or members within the organization (Schroeder et al., 2002). This interaction will be enhanced by IT use. Hao-Chen Huang, (2011) suggests that internal learning increases technological innovation capacity of a R&D team and this may result in an increase on product innovation. Considering the above, internal learning competency may represent the link helping a company to direct its IT competency toward improving the commercial success of innovation.

H2: Internal learning competency mediates the relationship between IT competency and the commercial success of innovation.

Shneiderman (2007) refers to IT as tools which facilitate social interaction inside the firm by creating networking between groups and individuals. An example of these may be message boards, email software, chat rooms, RSS technology to synthesize and share information from multiple sources and wikis and blogs to integrate knowledge and ideas. All the above accelerate knowledge transfer and innovation (Shneiderman, 2007) and will also is useful for generating external learning competency.

The ability to acquire, assimilate and exploit external knowledge is related to firm´s previous knowledge, which includes basic skills such as using a common language (Faems et al., 2007). Language homogeneity that occurs as a result of IT use facilitates the development of external learning competency. This IT increases the participation and dialogue between individuals with the aim of enhancing knowledge development and integration. Thus, IT tools can encourage and provide the capacity for formal social integration as well as for informal social integration (Joshi et al. 2010). For example, the use of video conferencing and group working facilitates formal integration, while others practical tools such as e-community and blogs, create opportunities for informal integration.

Dewet and Jones (2001) suggest that IT application increases the capacity to cope with external partners, customers and stakeholders by extending the limits of firm´s activities. Specifically, Su et al. (2006) argue that to extract customer knowledge from different market segments an important task is the conversion of tacit knowledge into explicit knowledge, this conversion could be allowed by information technology, such as web-based surveys and data mining. Similarly, Subramaniam and Youndt, (2005) explain that knowledge strengthening process promotes innovation capacity and this strength of the knowledge held by an organization improves depending of the quality of interaction and the kind of collaboration between individuals using the knowledge. Taking into account the above, we expect external learning competency will also help a company to direct its IT competency toward improving commercial success of innovation.

H3: External learning competency mediates the relationship between IT competency and commercial success of innovation.

4. METHODS

4.1 Sample

Given research purpose and subsequent lack of secondary data sources, we use surveys to obtain the necessary information for conducting this study. We focus on industrial companies since in this kind of firms knowledge acquisition is complementary to internal R & D, which contributes to the development of previous technological knowledge (Cassiman and Veugelers, 2006). This aspect will be important to examine both internal and external learning competency.

We focus on one industry since learning, involved in innovation process, is likely to be more homogeneous (Santarelli and Piergiovanni, 1996). Specifically, we examine Italian and Spanish ceramic tile industries, as they are fairly homogeneous population, and this allows us to control certain contingency factors such as size industry (Oltra and Flor, 2010).

Italian and Spanish ceramic tile producers have substantial common traits. Most of them are considered to be SMEs, as they generally do not exceed an average of 250 workers. They tend to be geographically concentrated in industrial districts (Hervás-Oliver et al. 2011). The Italian ceramic tile industrial district is located in Sassuolo (Northern Italy) and the Spanish one in Castellón (Eastern Spain) (Valencia, Chamber of Commerce, 2004).

In ceramic tiles production, technological accumulation is mainly generated by (1) knowledge, skills and techniques emerging from academicals chemistry researches (path based on science) and (2) design, development and operation of complex production systems. Previous studies provide compelling evidence that Italian and Spanish ceramic tile producers show a significant behavior toward innovation (Oltra et al., 2002).

The survey was conducted between October and December 2006 (Table 2).A pre-test was carried out on four technicians from ALICER, the Spanish Center for Innovation and Technology in Ceramic Industrial Design, to assure that the questionnaire items were fully understandable in the context of the ceramic tile industry. The questionnaire (see appendix) was addressed to two company directors; Product Managers answered items dealing with innovation commercial success, since product manager represents the person with more knowledge related to innovations activities within the firm (Calantone et al., 2002); while Human Resource Managers responded to items dealing with knowledge management (Wang, 2008) and information technology. To improve the response rate we offered to participant companies a report with results extracted from the study. The questionnaire was applied using a 7-point Likert scale.

The study received a total of 186 completed questionnaires, 89 from Spanish firms and 97 from Italian firms. The sample obtained represents around 50% of the population under study for both the Italian and the Spanish subsamples (Chamber of Commerce of Valencia, 2004). The number of responses and the response rate can be considered satisfactory (Spector, 1992; Williams et al. 2004).

To check for non-response bias, the sales turnover and number of employees of respondents and non-respondents were compared. This comparison did not reveal any significant differences. There are websites belonging to associations of ceramic tiles producers that provide this information for most companies in the industry, both in Italy (Assopiastrelle 2006) and Spain (Ascer 2006).

4.2 Measures

To measure the commercial success of innovation we use the scale proposed by Gatignon, Thusman, Smith and Anderson (2002) which is composed of 3 items. This scale has been used successfully by a number of empirical studies (Mu Di Benedetto, 2011).The measure consists on a 7-point Likert scales ranging from strongly disagree to strongly agree.

IT competency was measured using the measurement scale proposed by Tippins and Sohi, (2003). Three dimensions constitute the essential factors that represent ITC: ITC knowledge, ITC operations and ITC objects.
The ITC measurement scale was applied using a 7-point Likert scale, where 1 represent strongly disagree and 7 strongly agree.

The external learning competency consists of 5 items related to company's ability to acquire and create knowledge by collaborating with others outside the firm. And internal learning competency consists of 6 items related to firm´s ability to create and manage internal knowledge development (Annex 2). To measure both learning competences we used a 7-pointLikert scale, where 1 represented total disagreement and 7, total agreement. Both scales have been used successfully in previous studies (Alegre et al., 2011).

As control variable it was used market power. The aim is to control where power market has a significant impact on commercial success of innovation. For this it was collected information about firm market share and sales increase (7-point Likert scale).

4.3 Statistical Analysis

We used structural equation modeling with robust indicators to carry out the empirical test. Several problems normally occur in multiple regressions, but thanks to this type of second-order multivariate analysis, problems can be solved (Dhanarajan and Beamish, 2003). Especially, with this technique, we can analyze the existence of different relationships at the same time, including error measurement of the model. As a result, it is possible to identify a possible overestimation or underestimation of the strength of relationships between constructs. In addition, this technique confirms the reliability and validity measures of the constructs. Our research model was estimated using the EQS software 6.1. The sample comprised 186 companies which exceed the minimum limit of 100 subjects that is considered for analysis of structural equation modeling (Williams et al., 2004).

4.4 Psychometric properties of measurement scales

We used accepted practices to evaluate the psychometric properties of measurement scales (Tippins and Sohi, 2003); content validity, reliability, discriminant validity, convergent validity and dimensionality of the scale.

Content validity was established by means of personal interviews with experts of ceramic tile industry (four technicians in the area of design and architecture of the Technological Institute of Ceramics in Spain) and by reviewing existing literature.

Alpha coefficient and composite reliability indicator were estimated to assess the reliability of the scale resulting that all scales have an acceptable alpha coefficient and a reliability of composite indicators higher or proximate to 0.70.

Table 1. Correlations, means, standard deviations, and reliabilities

	Mean	s.d.	CR	1	2	3	4	5	6	7
1.- IT Knowledge	4,72	1,46	0,91	(0.88)						
2.-IT Operations	4,54	1,48	0.71	0,65**	(0.92)					
3.-IT Objects	4,12	1,59	0.67	0,58**	0,64**	(0.83)				
4.-Int. learning Competency	3,97	1,61	0.95	0,21**	0,11	0,21**	(0.94)			
5.-Ext. learning competency	3,96	1,42	0.94	0,09	-0,03	0,13	0,74**	(0.88)		
6.-Commercial success of innov.	5,26	1,51	0.94	0,30**	0,12	-0,06	0,22**	0.00**	(0.90)	
7.-Market power	4,53	1,50	0.89	-0,09	0,03	0,04	0,52**	0.48**	0.09	(0.82)

NOTE: ** Correlation is significant at the 0.01 level; alpha reliabilities are shown on the diagonal; Composite reliabilities are shown in columne CR.

Confirmatory factor analysis (CFA) (Annex 1) was carried out to test discriminated validity through comparison of the $\chi 2$ differences between a constrained confirmatory factor model (where the correlation between two factors is set to 1, indicating they are the same construct) and an unconstrained model (where the correlation between two factors was free). The evidence of discriminant validity was provided because all $\chi 2$ differences were significant (Gatignon et al., 2002). CFA was also used to establish convergent validity by confirming that all scale items loaded significantly on their hypothesized construct factors (Anderson and Gerbing 1988). Additionally, convergent validity was confirmed by comparing the $\chi 2$ differences between a model "constrained confirmatory" with an interfactor correlation set to 0 (indicating no relationship between the two constructs) and an unrestricted model with an interfactor correlation "set free". All $\chi 2$ differences were considered significant, providing evidence of convergent validity (Gatignon et al., 2002).

We tested the dimensionality of the constructs by means of the loadings of the measurement items on the first-order factors, and the loadings of the first-order factors on the second-order factors. All loadings were higher than 0.40 and significant ($p<0.001$). There were no crossed loadings.

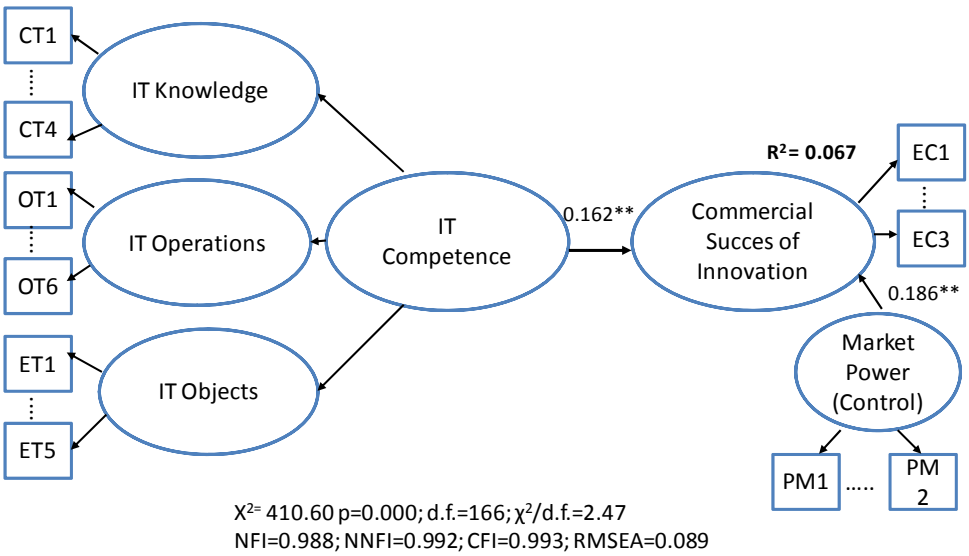
To avoid problems of common variance, we used different informants within the same company. Specifically, the Human Resources Manager answered questions related to internal and external learning competences and the Production Manager answered questions concerning to IT competency and commercial success of innovation.

5 RESULTS

The $\chi 2$ statistic is the most used tool to measure model fit indices and is especially recommended to test mediating effects such as the one proposed in the present study.. The first model examined the direct effect between IT competency and commercial success of innovation. This model was used to test Hypothesis 1, which suggests a

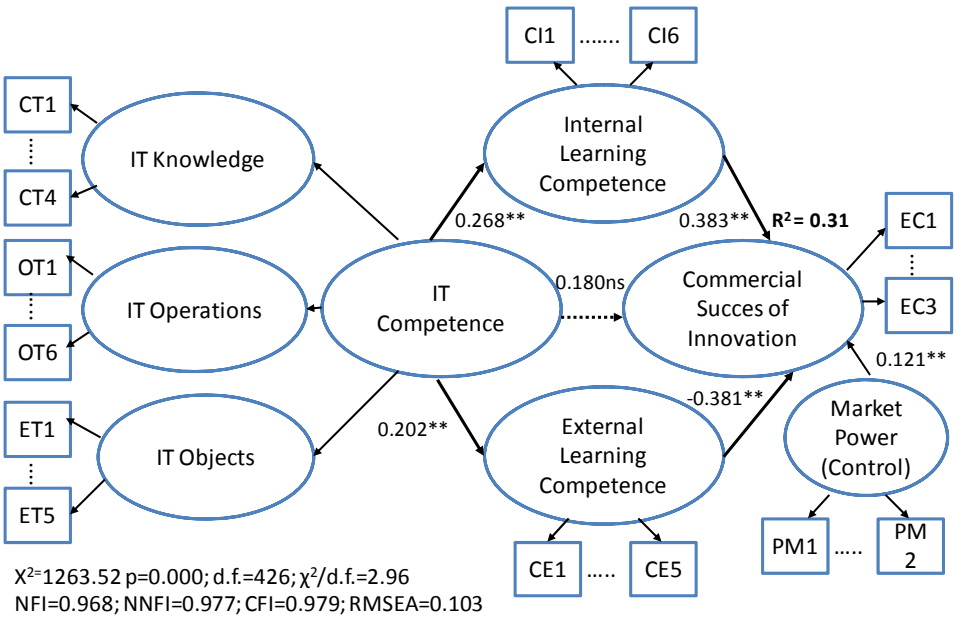
positive and significant relationship between IT competency and commercial success of innovation. As shown in Figure 1, the χ2 statistic is significant and other relevant indices indicate good overall fit (Tippins and Sohi, 2003). This finding provides support for our first hypothesis.

Figure 1: Direct effect model



The second model includes internal and external learning competences as mediating variables of the above relationship. The inclusion of these variables in the analysis helps to provide an explanation for the positive relationship between IT competency and commercial success of innovation. Figure 2 shows the results of the analysis. The χ2 statistic for each model is significant and the indices are higher than 0.90 suggesting a good overall fit (Tippins and Sohi, 2003).

Figure 2: Mediation model



The mediating effect of internal and external learning competences in the relationship between IT competency and commercial success of innovation is demonstrated, as suggested by Tippins and Sohi (2003), by the following sequence: (1) First, partial mediation model explains more the variance of the dependent variable than the direct

model (R2 = 0.26 vs. R2 = 0.06); (2) a positive relationship between IT and internal and external learning competences was found; (3) there is a positive relationship between internal and external learning competences and commercial success of innovation; and (4) the significant relationship between IT competency and commercial success of innovation becomes not significant in the partial mediation model. Together, these four points provide compelling evidence that there exist a significant mediating effect of internal and external learning competency on the relationship between IT competency and commercial success of innovation. Thus, in our opinion, the partial mediation model represents a significant contribution of the positive influence - which is supported by both theory and some previous empirical researches - of IT competency on commercial success of innovation.

6. DISCUSSION

The possibility that IT competency can provide firms with a basis of competitive advantage has received a great deal of attention (Tipping and Sohi, 2003). Although it is considered that IT investment has a positive impact on business results, it seems that the relationship does not occur in all cases (Badescu and Garces-Ayerbe, 2009). Tippins and Sohi (2003), in an attempt to shed light on the controversy cited above, proposed organizational learning as an intermediate variable in this relationship. Organizational learning is necessary to help IT investment cause better overall results. We consider that more effort is needed for understanding this phenomenon. Therefore, we set a new dependent variable closely linked to business results, the comercial success of innovation. According to previous studies, firms with more innovative performance also obtain a better overall performance (Baker and Sinkula 2009). We also included two intermediate variables, internal and external learning competency.

Our main objective is to evaluate the effect of IT competency and internal and external learning competency on innovation commercial success. We attend to explain why commercial success of innovation varies among companies. To do this, we focus on one industry, the Italian and Spanish ceramics tile industry, which is a world leader in terms of technology, productivity, quality and design. When assessing both the direct and indirect effects of IT competency and internal and external learning competences on the firms´ commercial success of innovation, we found that the indirect effects prevail over direct. This means that the IT competency can improve sustainable competitive advantages that come from commercial success of innovation, but it is done indirectly through internal and external learning competences. Therefore, sustainable competitive advantages in the ceramic tile industry will require strategies focusing their attention on IT competency. However, the internal and external learning competences should be attentively looked at, since the impact of IT competency on commercial success of innovation is mediated by the first. Innovation is an important output within business processes and is also critical for a successful economic performance.

Secondly, as companies are increasing the use of digital media systems and pushing their knowledge management initiatives, researchers on information systems highlight the need for more studies aimed at understanding the role of IT on knowledge management processes and companies innovation (Alavi and Leidner, 2001; Sambamurthy and Subramani, 2004; Joshi et al., 2010). Thus, our conceptualization and empirical research helps to enrich the literature on this topic.

Surprisingly, although the relationship between internal learning competence and commercial success of innovation is positive, our results show a negative relationship between external learning competence and commercial success of innovation. To understand this result we observe the correlations of the variables that composed the construct in relation with the commercial success of innovation and we find that those variables which show stronger negative relationship with respect to commercial success are those related to collaboration with competitors (industry associations composed by industry companies and therefore companies competing with each other). The literature said that the cooperation with competitors is considered by some industries as dangerous. Despite the advantages of collaborating with competitors, among others, sharing technological knowledge or reducing the time and risks of large projects, competitors are potentially dangerous because they sell on similar markets and may access the firm's own R&D resources (Tsai 2009). This risk is understood by Veugelers & Cassiman (1999) as possible "involuntary outgoing spillovers" and it explains why accessing competitor's knowledge is the less frequent source. We understand that this is the case of the ceramic industry.

These results have important implications for decision making on IT and internal and external learning competences, especially in the context of commercial succes of innovation. This study also reinforces the new trends in research on the resources-based view which we seek for, not only to identify critical specific assets for a particular industry, but also to improve our understanding of how this happens in changing environments, by considering the dynamic capabilities.

From a practical point of view, our results show that simple investment in IT per se, cannot provide strategic value, but will help to support and reinforce key organizational capabilities for innovation and competitive advantage. Companies should focus their attention on mediating factors such as internal and external learning competences in order to determine what benefits derive from IT investments. The results suggest that managers should not focus on examining the direct impact of IT, but rather they should find ways to improve its role in raising and strengthening organizational learning competences.

6.1 Limitations

The results presented here should be viewed in light of the following limitations. First, the data were gathered at one point in time, so we can neither conclusively demonstrate causality nor rule out reverse causality. Furthermore, the target population of this study was narrowly defined to include a fairly homogeneous set of firms. Although a restrictive sampling approach enhances confidence that the findings are indeed a result of the hypothesized relationships, it may also limit the generalizability of research results.

6.2 Future research

The results of this study provide guidance for future research. The mediating effect of internal and external learning competences must be taken into account in researchers studying IT competency and commercial success of innovation. The relationship between IT competency and commercial success of innovation needs further analysis from a longitudinal perspective. Future pieces of research could also distinguish

between radical and incremental product innovation. Moreover, it is relevant to study other types of sectors, such as tourism sector (Alford and Clarke, 2009) and could be interesting to compare between different industries.

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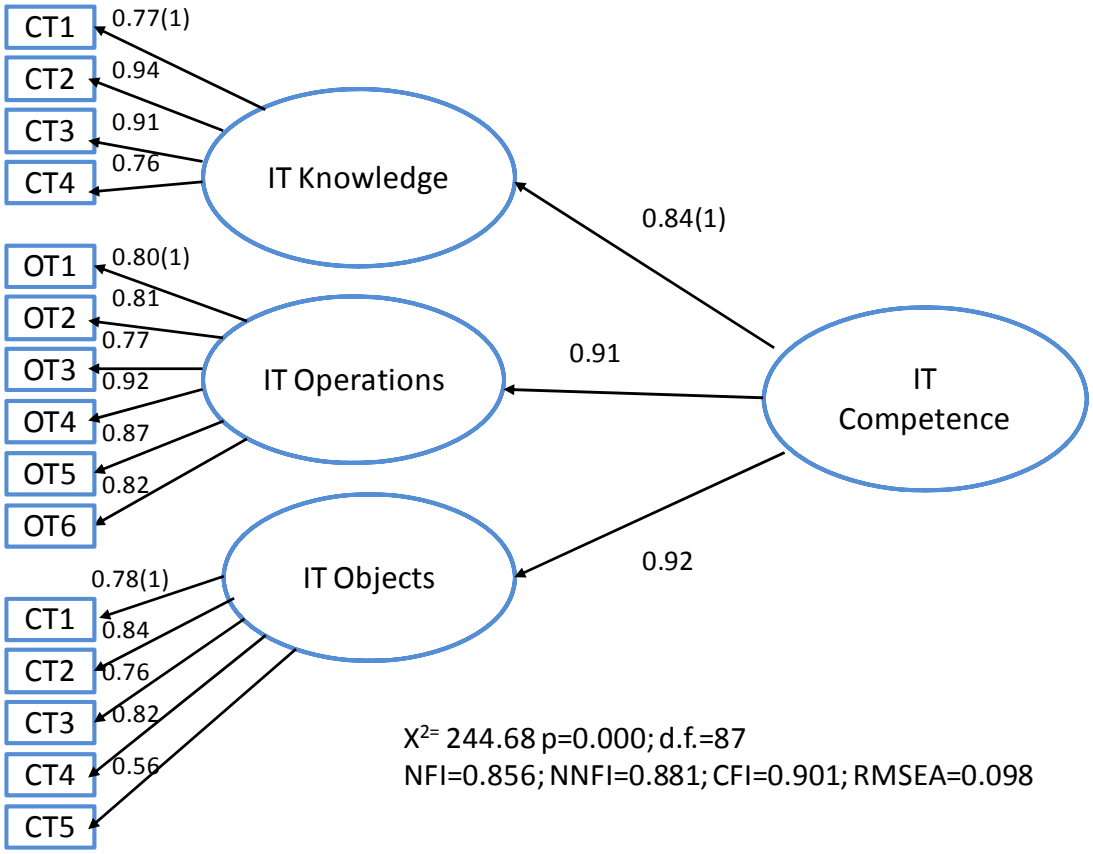
Figure 3: CFA of Information Technology Competency

Annex 1.



Annex 2.

Table 2: Questionnaire

A.- IT COMPETENCY

Please, indicate the degree of agreement or disagreement with the following statements related to ITC (7-point Likert scale):

IT KNOWLEDGE	Tippins y Sohi (2003)
CT1. Overall, our technical support staff is knowledgeable when it comes to computer-based systems.	
CT2. Our firm possesses a high degree of computer-based technical expertise.	
CT3. We are very knowledgeable about new computer-based innovations.	
CT4. We have the knowledge to develop and maintain computer-based communication links with our customers.	
IT OPERATIONS	
OT1. Our firm is skilled at collecting and analyzing market information about our customers via computer-based system.	
OT2. We routinely utilize computer-based systems to access market information from outside databases.	
OT3. We have set procedures for collecting customer information from online sources.	
OT4. We use computer-based systems to analyze customer and market information.	
OT5. We rely on computer-based systems to acquire, store, and process information about our customers.	
IT OBJECTS	
ET1. Our company has a formal MIS department.	
ET2. Our firm employs a manager whose main duties include the management of our information technology.	
ET3. Every year we budget a significant amount of funds for new information technology hardware and software.	
ET4. Our firm creates customized software applications when the need arises.	

B.- KNOWLEDGE MANAGEMENT DYNAMIC CAPABILITY

Please state the performance of your company as compared with your competitor in the following terms:

EXTERNAL LEARNING COMPETENCY	
CE1. Ability to obtain information about state-of-the-art scientific and technological developments through technological surveillance systems	Fleisher (2001); Chang (2003)
CE2. Effective and updated competitive intelligence	Fleisher (2001); Myburgh (2004)
CE3. Ability to create knowledge through cooperation with industry associations	Chang (2003)
CE4. Ability to create knowledge through cooperation with R&D institutions such as universities and technological institutes	Chang (2003)
CE5. Technology acquisition (patents, equipment, etc.)	Jacobsson et al. (1996)
INTERNAL LEARNING COMPETENCY	
CI1. **Degree of academic qualification of employees in the R&D function**	Jacobsson et al. (1996)
CI2. Ability to be positioned on the technological front line/frontier	Wheelwright y Clark (1992); Tidd, Bessant y Pavitt (1997)
CI3. Ability to manage the innovation effort	Takeuchi y Nonaka (1986); Tidd et al. (1997)
CI4. Ability to assess innovation projects	Wheelwright y Clark (1992); Tidd et al. (1997)
CI5. Suitability of human resources devoted to the R&D function	Jacobsson et al. (1996)
CI6. Ability to coordinate and integrate the different innovation project phases and the consequent interfunctional interphases between engineering, production, and marketing	Takeuchi y Nonaka (1986); Weelwright y Clark (1992)

E.- TECHNOLOGICAL INNOVATION

Referring to the most important technological innovation obtained in last three years, state the degree of agreement or disagreement with the following statements (7-point Likert scale)

COMMERCIAL SUCCESS OBTAINED FROM PRODUCT INNOVATION	
EC1. innovation was successfully implemented at the company	Gatignon, Tushman, Smith y Anderson (2002)
EC2. Innovation has led to commercial success	Gatignon, Tushman, Smith y Anderson (2002)
EC3. Innovation has achieved the expectations of the company in terms of impact on sales	Gatignon, Tushman, Smith y Anderson (2002)