The relation between IT competency and knowledge management processes and its mediators

A relação entre as competências de TI e os processos de gestão do conhecimento e seus mediadores

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ABSTRACT

The past two decades have seen growing interest in knowledge management and the use of information technologies. However, it is not clear how the relation between IT competency and knowledge management works. This study provides a better understanding of that relation. Through an empirical study of 162 Spanish firms, the work finds that no direct relation exists between IT competency and knowledge management. Open organization and empowerment mediate the relation between IT competency and knowledge management processes. These findings reinforce a field that is of increasing interest to researchers, and which has seen only a limited number of empirical studies to date.

Keywords: IT competency, knowledge management processes, open organization, empowerment.

RESUMO

As duas últimas décadas têm visto um interesse crescente na gestão do conhecimento e do uso das tecnologias da informação. No entanto, não está claro como a relação entre as competências de TI e a gestão do conhecimento funciona. Este estudo fornece uma melhor compreensão dessa relação. Através de um estudo empírico de 162 empresas espanholas, o trabalho conclui que não existe relação direta entre as competências de TI e a gestão do conhecimento. Organização aberta e delegação de responsabilidade medeiam a relação entre as TI e os processos de competência de gestão do conhecimento. Estes resultados reforçam um campo que é de interesse crescente para os investigadores, e que viu apenas um número limitado de estudos empíricos até o momento.

Palavras-chave: Competências de TI, processos de gestão do conhecimento, organização aberta, delegação de responsabilidade.

1. Introduction

Firms are facing a competitive environment characterized by the globalization of markets, increasingly complex business problems, and the acceleration of change phenomena. Consequently, the traditional sources of competitive advantage, such as protected markets, and physical and financial assets, have lost importance compared to knowledge assets (Foray and Lundvall, 1996; Grant, 1996; Johnston and Rolf, 1998). This has contributed to the growing interest in the concept of knowledge management in the past two decades.

Knowledge management has emerged as a discrete area in the study of organizations and is frequently cited as an antecedent of organizational performance. If organizations implement knowledge management practices successfully they are able to perform intelligently to sustain their competitive advantage by developing their knowledge assets (Wigg, 1999). Thus, it is essential to know how to generate knowledge, how to disseminate it in the organization and what factors facilitate these processes (Stewart, 1997).

In recent years, several researchers have associated knowledge management with the development of information and communication technologies, or IT (Scott, 2000; King, 2005). The new technologies are characterized by their capability to influence the traditional ways of understanding certain organizational phenomena and behaviors and affect how organizations tackle the challenges thrown up by the knowledge society (Duffy, 2001). Researchers have gone from studying the effects of IT on economic-financial variables to studying its complementarity with intangible resources such as knowledge (Martin *et al*., 2004). But it is not clear how the relation between IT competency and knowledge management works. Empirical work in this area is lacking.

Thus, the objective of this paper is to develop a better understanding of how IT competency affects knowledge management. This study proposes a theoretical model whose basic contention is that the relation between IT competency and knowledge management is two-fold: both direct and indirect. Information competency can directly influence the knowledge management processes. They can also indirectly influence knowledge management by affecting contextual factors such as open organization and empowerment, which, in turn, influence knowledge management. The following sections discuss the concepts of knowledge management and IT competency. Then, the hypotheses representing the relations between IT competency, open organization, empowerment and knowledge management are formulated. The hypotheses are tested with the structural modeling technique, using data collected from managers in 162 Spanish firms. The work concludes with a discussion of the results and their implications.

2. Knowledge management processes

Defining the concept of knowledge management is not straightforward, because this subject has been studied by several disciplines and from different approaches. However, there seems to be a consensus to treat knowledge management as a set of processes allowing the use of knowledge as a key factor to add and generate value (Alavi and Leidner, 2001). An examination of the characteristics of knowledge processes enables us to group them into the three broad dimensions of knowledge acquisition, transfer and use.

Knowledge acquisition can be defined as the process by which the firm obtains knowledge, either from outside the company or generated internally (McCann and Buckner, 2004). The objective is to obtain new and better knowledge that helps the organization improve its competitiveness. Thus, knowledge generation is not just about generating new contents, but also about replacing, validating and updating the firm's existing knowledge (Alavi and Leidner, 2001; Bhatt, 2001).

Knowledge transfer refers to the process by which the organization shares knowledge among its units and members, promoting new understanding (Alavi and Leidner, 2001). It is essential for the firm to develop an adequate design of informative interaction networks that allow individuals of diverse specialties, cultures, and geographic locations, not only to access the same information, but also to come together through the network to undertake a particular project.

Moreover, for the transfer of tacit knowledge—which requires more interaction between the individuals— the firm must develop mechanisms that encourage dialogue and interaction (Fox, 2000).

Finally, knowledge use is a very important process in the effective management of knowledge (Bhatt, 2001). The existing knowledge must be captured, codified, presented and put in stores in a structured way, so it can be re-used later (Choi *et al*., 2008). Some authors suggest that the effective use of knowledge is one of the most challenging aspects of knowledge management. It is through application to products and services that stored knowledge can be transformed into a dynamic capability (Zahra and George, 2002).

3. IT competency

Firms need internal information about their financial situation, the effectiveness of their products, their production costs, and so on. And they need external information about the environment in which they operate—competitors, customers, suppliers, etc.-that helps them to get to know their customers and satisfy them immediately and effectively, and so gain sustainable competitive advantages (Lai *et al*., 2006).

Following Tippins and Sohi (2003), this study defines IT competency as how the firm uses these technologies to manage its information effectively. While IT is a generic term fundamentally used to refer to programs, computers and telecommunications, the term IT competency is broader and refers to the use of these technologies to satisfy the firm's information needs (Mithas *et al*., 2011). In this study we differentiate between three dimensions of this concept: IT knowledge, IT operations, and IT infrastructure. These dimensions represent co-specialized resources that indicate the organization's capability to understand and use the tools necessary for managing information about markets and customers (Tippins and Sohi, 2003). Brief definitions of these three dimensions follow.

IT knowledge. This dimension describes the degree to which the organization understands the capabilities of existing and emerging IT. An awareness of IT "possibilities" exposes the universe of digital options available to the organization, providing the flexibility to quickly adapt to emerging market opportunities (Crawford *et al*., 2011).

IT operations. This concept refers to the IT-related methods, processes and techniques that may be needed if these technologies are to create value. In the context of the current study we define IT operations as the extent to which the firm uses IT to improve its effectiveness and decision-making.

IT infrastructure. IT infrastructure refers to artifacts, tools and resources that contribute to the acquisition, processing, storage, dissemination and use of information. According to this definition, the IT infrastructure includes elements such as hardware, software and support staff.

4. Theoretical model and hypotheses

On the basis of the previous sections we propose three hypotheses about the relations between IT competency and knowledge management.

4.1. It competency and knowledge management processes

In recent years, several researchers have associated knowledge processes with the development of information technologies, or IT (King, 2005; Choi *et al.,* 2010). IT can enable rapid search, access and retrieval of information and can support collaboration and communication between organizational members (Ho, 2009; Migdadi, 2008). In essence, IT competency can play a variety of roles to support the organization's knowledge management processes.

In the current environment, a highly integrated IT infrastructure provides organizational members with a quick and effective access to the right amounts of information and facilitates the process of knowledge transfer. Technology enables individuals to coordinate the logistics of face-to-face meetings. It can also be used to catalog the expertise of organizational members, and so facilitate access to the right people and enhance knowledge sharing (Al-Hawamdeh, 2002). Certain systems (e.g., groupware or collaborative systems) provide a virtual space where the participants can process the information and knowledge in real time, giving them more chance to interact (Lee and Choi, 2003).

Likewise, IT infrastructure facilitates the standardization and automation of certain tasks, supporting the transformation of tacit knowledge into explicit knowledge (Alavi and Leidner, 2001). Similarly, IT infrastructure also provides the necessary mechanisms to routinize enterprise processes and practices and to enhance knowledge application in daily work procedures.

But IT infrastructure is just one requirement for knowledge management processes. It needs to be complemented with IT knowledge and IT operations.

IT operations involve applying IT to business processes (Crawford *et al.,* 2011). IT operations enable firms to better manage their customer bases, keep information about customers in a more organized manner and also share knowledge within the organization more efficiently. Effective IT operations require skills, such as managerial skills and problem-solving skills, in addition to core technical skills (Bharadwaj, 2000; Zhang *et al*., 2008). The managerial ability to coordinate the multifaceted activities associated with successful IT implementation is critical to knowledge management processes (Nfuka and Rusu, 2011).

IT knowledge fosters a holistic understanding of knowledge needs across business units, facilitates identification of knowledge resources that are applicable across multiple units, and encourages business units to invest not only in their own IT infrastructures, but also in boundary-spanning IT initiatives that are critical for KM processes (Bhatt and Grover, 2005). IT knowledge determines the ability to assimilate knowledge from outside and create new knowledge from a reinterpretation and reformulation of existing and newly acquired information.

Taken together, these three dimensions of IT competency interact and provide an indication of the organization's ability to understand and utilize the IT tools and processes that are needed to manage knowledge appropriately. Given this theoretical framework, the first hypothesis of this work is as follows:

H1. IT competency has a positive effect on the knowledge management processes.

4.2. The relations between it competency, open organization, empowerment and knowledge management processes

The most traditional literature has focused its analysis on the direct relationship between IT and knowledge management. However, the impact of IT competency on the knowledge management processes may also be moderated by changes within organization. The development of IT is having a considerable effect on firms, and researchers argue that these technologies have a critical role in the appearance of new ways of management.

In this section, we discuss the influence of some variables (i.e., open organization and empowerment) on the IT competency and knowledge management relationship. Open organization is defined as the extent to which an organization favor cooperation and open relationship with minimal formalization. In open organizations, job behaviors are relatively unstructured and

members have greater freedom in dealing with the demands of their relevant tasks (Sivadas and Dwyer, 2000).

Researchers argue that IT has a critical role in the appearance of new organizational forms, which go under a large number of names. These technologies are considered the causes of the structural changes and of the emergence of new organizational forms with a lower level of formalization, where there is a more fluid communication and cooperation is promoted (Barley, 1990; Malone, 1997; Robey *et al*., 2000). IT competency integrates fragmented flows of knowledge. This integration can eliminate barriers to communication among departments in organization. A less formalized work process is therefore more likely to encourage social interactions among organizational members.

Thus, the link between IT competency, open organization and knowledge management processes are evident, because knowledge management processes requires shared understanding among organizations members and supportive and reflective communication. From this discussion, we propose the following hypothesis:

H2. *IT competency has an indirect effect on knowledge management through its positive effect on open organization.*

IT competency leads to the development of more decentralized work models within an organization. Workers have a wide authority delegation and a remarkable autonomy to solve new problems. Likewise, IT are able to help disseminate any information about the aims and to impregnate the whole organization because of its mission and vision. It facilitates the objective compatibility and the employees' compromise with the business project where they are participating.

Definitively, the use of tools to disseminate the information within the firm widely leads to a decentralization of the decision power and the initiative is boosted. Our idea of empowerment -obtained from Maynard *et al*. (2012)- integrates the both conceptualizations of empowerment. The first conceptualization focuses on the transition of authority and responsibility from upper management to employees. The second one (Kanter, 1977) focuses on individuals or teams perceiving that they are in control of their work (Conger and Kanungo, 1988; Thomas and Velthouse, 1990; Spreitzer, 1995). Such processes clearly influence knowledge management.

In fact, IT are tools to work with sketches where workers obtain an high level of decentralization and have a remarkable autonomy to evaluate competences, discuss the alternatives suggested and choose one of them to solve the approached problems, whatever it is (Huerta and Larraza, 2001).

First, it facilitates the assimilation and association of new patterns. Second, it allows changes in behavior, beliefs and actions and thirdly, it encourages the participation of employees who acquire a fundamental relevance, because the organizations try to retain workers with specific abilities which favor learning, knowledge generation and efficient performance. From an empirical point of view, the literature is scarce. We have found a case analysis (Doherty and Doig, 2003) that shows how the explicit use of information technologies allows empowerment of staff. Summarizing these arguments, we offer the following hypothesis:

H3. *IT competency has an indirect effect on knowledge management through its positive effect on empowerment.*

5. Methodology

5.1. Sample and data collection

The first step in testing the above hypotheses was to choose the population object of analysis. This study focuses on IT competency, so the sectors of reference are those that use these technologies most intensively. The sectors included are as follows: electrical energy, gas and water, paper industry, publishing and graphic arts, electronic, electrical and optical equipment, transport and communications, financial intermediation, business services, health and private social services, and other social and service activities.

After choosing the sectors, the population object of study was specified more precisely. This work uses 1660 Spanish firms from the SABI database satisfying the following requisites: belonging to one of the above-mentioned sectors, with a sales volume exceeding €10 million, and employing at least 50 workers. Large firms use IT more than SMEs, which is the reason for choosing reasonably sized firms.

The sampling unit chosen was the managing director, who had been identified as the appropriate key respondent based on two criteria: (a) possession of sufficient knowledge; and (b) adequate level of involvement with regard to the issues under investigation (Campbell, 1955).

A number of approaches were used to ensure response quality and to enhance the response rate. These collectively constitute a modified version of Dillman's (1978) "total design method". More specifically, the process was organised as follows: first, the research instrument was pre-tested twice. In its draft form, it was pre-tested with the managing directors from four companies. A second pre-test was conducted after in-depth discussions with academics and questionnaire design experts. This second pre-test involved seven firms. After some minor modifications, the final questionnaire was mailed to managing directors together with a letter explaining the purpose of the study and assuring anonymity.

To check the representativeness of the sample, the sample and the population were compared in terms of two criteria: the company and the sector of activity (differentiating between industrial companies, financial companies and non-financial service companies). The test (chi-square) shows that no significant differences exist between the sample and the population. The next analysis was to determine whether any differences exist in the means of all the variables used in the study between early and late respondents. The rationale behind such an analysis is that the late respondents (i.e., sample firms in the second wave) are more similar to the general population than the early respondents (Armstrong and Overton, 1977). These comparisons do not reveal any significant differences, indicating that non-response bias is not a serious issue in this study.

5.2. Measures

This section describes the scales used to measure IT competency, knowledge management processes, open organization and empowerment. All the variables were measured on Likert 5-point scales ranging from 1=strongly disagree to 5=strongly agree.

Knowledge management processes. The scale of knowledge management was generated using some of the items from the scales proposed by Gold *et al.* (2001) and Zaim *et al*. (2007). The remaining items were built after theoretical contributions and extensive discussions with academics and chief executives during the pre-testing phase of the questionnaire development.

IT competency. This scale was adapted from Tippins and Sohi's (2003) scale, and includes 11 items to measure the dimensions of IT knowledge, IT operations and IT infrastructure.

Open Organization. To measure this construct, the authors selected three items evaluating organizations' degree of formalization, cooperation and open communication that are adapted from Pugh *et al*. (1969) and Miller (1987).

Empowerment. Empowerment was measured 3 item-scale adapted from Greasley *et al.* (2005). The scale measures delegation of authority and responsibility to employees.

6. Analysis and results

The psychometric properties of the measurement scales were assessed following accepted practices (Gerbing and Anderson, 1988; Bagozzi and Yi, 1988). These included establishment of content validity and construct validity. Content validity was established through personal interviews with academics and chief executives during the pre-testing phase of questionnaire development. We tested the construct validity of the measures employing confirmatory factor analysis (CFA) using EQS (Bentler, 1995). A series of empirical tests examined the measurement properties of the indicators: reliability, convergent validity, discriminant validity and dimensionality. All these tests were found satisfactory. Table 1 shows descriptive statistics, reliability indicators and correlations of the constructs.

Table1. Factor correlations, means, standard deviations and reliabilities

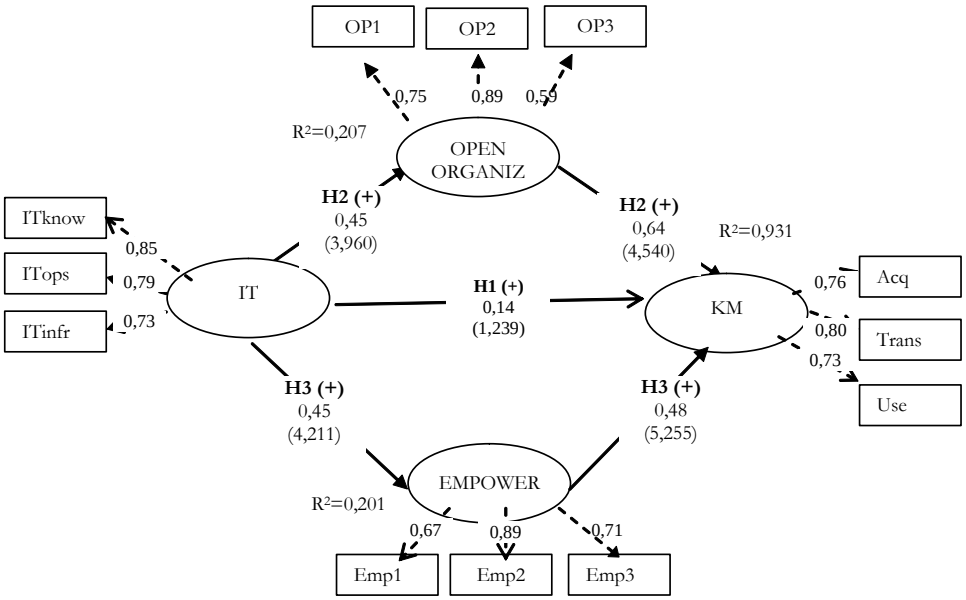
	Mean	S.D.	Reliability	IT KNOW	IT OPS	IT INFR.	ACQU	TRANSF	USE	OPENO	EMPOW
IT KNOW	3.887	0.844	0.920	1.000							
IT OPS	3.756	0.825	0.803	0.668**	1.000						
IT INFR	4.102	0.945	0.877	0.652**	0.551**	1.000					
ACQU	3.708	0.708	0.818	0.343**	0.509**	0.240**	1.000				
TRANSF	3.698	0.734	0.836	0.348**	0.372**	0.284**	0.580**	1.000			
USE	3.670	0.631	0.770	0.363**	0.413**	0.332**	0.602**	0.549**	1.000		
OPENO	3.320	0.588	0.793	0.166*	0.250**	0.142*	0.223**	0.374**	0.340**	1.000	
EMPOW	2.103	0.514	0.804	0.208**	0.269**	0.231**	0.491**	0.512**	0.516**	0.254**	1.000

*Correlation significant at 0.05 level
** Correlation significant at 0.01 level

Furthermore, we conducted a Harman´s single-factor test (Podsakoff *et al.,* 2003) to assess whether common method variance exits and to deal with the potential social desirability of the responses. The results of the CFA with the eight indicators loading into a single-factor (S-Bχ^2= 326.788, d.f. =28, p= 0.000; RMSEA = 0.163; NNFI = 0.598; CFI = 0.713) showed a poor fit, suggesting that the single-factor does not account for all of the variance in the data.

To test the hypotheses proposed in the theoretical section of this study, a structural equation model was estimated using the statistics package EQS Version 6.1. This analysis enabled the evaluation of the relations between IT competency, open organization, empowerment and knowledge management processes. Figure 1 depicts the specific model that was evaluated. This figure shows the fit indices, the variance explained by the model (R^2), the standardised path coefficients (β) and the t-values.

Figure 1. Representative model of relations between IT Competency, Open Organization, Empowerment and Knowledge Management Processes



Notes. Relation diagram shows standardised parameters. T- student statistic in brackets.
Model summary statistics: S-Bχ^2= 79.9782, d.f. =49, p= 0.00341; RMSEA = 0.063; NNFI = 0.900; CFI = 0.93

As the figure shows, the overall model demonstrates an acceptable fit. Although the Satorra-Bentler statistic is significant, there is much discussion in the literature about whether this test is really a valid indicator of the model fit, given its sensitivity to sample size. Consequently, the current study also uses the indices NNFI, CFI and RMSEA. Their values are in all cases at acceptable levels. The rest of this section outlines the findings for the hypotheses.

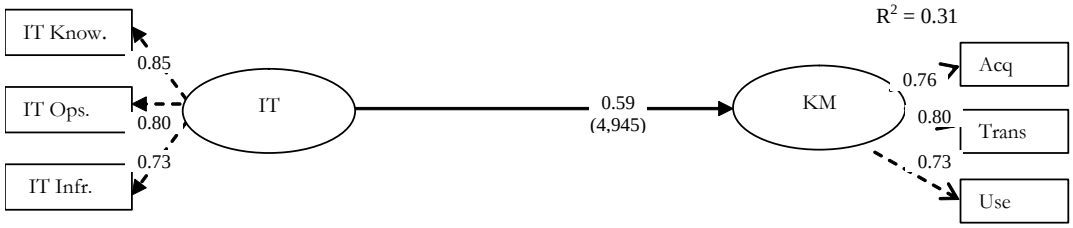
First, the results show that no direct relation exists between IT competency and knowledge management processes (H1: β = 0.14, t = 1,239), thus H1 is not supported.

Second, the results provide support for hypotheses H2. There is a significant positive relationship between IT competency and open organization (H2: β = 0.45, t = 3.960) and between open organization and knowledge management processes (H2: β = 0.64, t = 4,540). Thus, there is a relation between IT competency and knowledge management processes indirect and via open organization.

Third, the results provide support for H3. The results show that IT competency influence knowledge management processes indirectly, via empowerment. Positive relationships exit between IT competency and empowerment (H3: β = 0.45, t = 4.211) and empowerment and knowledge management processes (H3: β = 0.48, t = 5.255).

To provide additional evidence of the suitability of this indirect model, adopting the approach used by Singh et al. (1994), it was compared with a model in which the relationship between IT competency and knowledge management processes is only direct. Figure 2 shows the results of the direct model. Although both models have a good fit, the indirect model explains more variance of knowledge management processes (0,931 vs 0,31). Moreover, the significant relationship between IT competency and knowledge management processes indicated in the direct effects model (β =0.59, t = 4.945) becomes non-significant in the indirect model (β = 0.14, t = 1,239). Together these two points provide that there is a discernible mediating effect of open organization and empowerment between IT competency and knowledge management processes.

Figure 2. Representative model of the relation between IT Competency and Knowledge Management Processes



Notes. Relation diagram shows standardised parameters. T- student statistic in brackets.
Model summary statistics: S-Bχ2= 15,8055, d.f. =8, p= 0.04525; RMSEA = 0.078; NNFI = 0.933; CFI = 0,965

7. Discussion

In recent years a large number of studies have stressed the importance of IT for knowledge management. But it is not clear how the relation between knowledge management and IT competency works. This is due to a number of reasons.

The literature generally recognizes that IT has a positive effect on knowledge management, but researchers do not empirically analyze how IT affects. In fact, previous studies had not empirically analyzed the indirect relation between IT and knowledge management. The current work analyzes how IT indirectly influences knowledge management by affecting contextual factors, such as an open organization and the empowerment. The introduction of information systems promotes greater dissemination of information to all individuals, which ultimately facilitates the different processes of generation and transformation of knowledge. That is, the introduction of information systems fosters the effects of an open organization and, as a result, information to all of the individuals is disseminated more widely. Therefore, the processes of generation and transformation of knowledge are easier.

Likewise, empowerment leads to similar effects. The literature about its intermediary role as a driving force allowing information technologies to foster generation and transformation of knowledge is scarce. These results are consistent with the ones in other fields (for example, environmental management). Gupta and Sharma (1996) have suggested that the empowerment is based on a team of workers that will probably have specific knowledge about the causes of waste and the possible solutions to reduce it. If we broaden these ideas to the influence of information technologies on knowledge management, said reasons are able to explain the influence of information technologies on knowledge management because of their capabilities to disseminate knowledge. As a result, information technologies create a suitable context to delegate authority to employees in an effective manner, as Doherty and Doig (2003) by the findings of their case analysis.

Finally, many research works measure IT using global spending or investment. There is considerable debate about whether this is suitable given the problems observed in estimating monetary values. Rapid technological development, falling equipment costs, and the spread of all sorts of different technologies throughout the firm mean that measurements of monetary aggregates are frequently of dubious reliability (Piñeiro, 2006). On the other hand, other authors have focused on the adoption of a specific technology as an approximation to the firm's IT competency. For example, Hayes *et al*. (2001) find increases in market value after announcements of the adoption of ERP systems. This study, in contrast, opted to evaluate IT from a broader perspective. The objective is to measure the use of technologies to manage the information inside the firm effectively, so the work considers three dimensions of IT competency: IT knowledge, IT operations and IT infrastructure. It is necessary to consider factors such as the firm's knowledge, skills and experience in the use of IT, the tools and systems that the firm uses to acquire and store information that is useful in the decision-making, and also the firm's infrastructure, which involves aspects such as whether the firm develops software tailored to its own needs, the allocation of funds to acquire new equipment, or the existence of a person or department in charge of IT.

8. Conclusions, limitations and future lines of research

To summarize, this study contributes empirical data to the predominantly theoretical literature on knowledge management and IT competency. It is, to a certain extent, common sense that IT has a positive impact on knowledge management. However, this paper takes an important step forward by detailing how IT competency influences knowledge management indirectly, favoring the development of an open organization and empowerment that in turn favor knowledge transmission.

Moreover, the findings of the research also have important implications for managers. Managers should not only focus on allocating sufficient resources for IT investments. Firms must focus their attention on intervening processes such as knowledge management in order to determine what benefits are being derived from IT-based information systems. In order to meet this challenge, the authors recommend developing an information and knowledge strategy before developing an IT strategy. This is in line with Fielder *et al*. (1994) and Johannessen *et al*. (1999), who argue that when applying IT, it should not be assumed that the design of the original process is satisfactory. This implies that before developing an IT

strategy, firms must develop a knowledge strategy to provide the basis for the IT strategy, not the other way around. Organizations lacking such a strategic foundation could fail to understand the complementarities between IT and information and knowledge resources in the organization and consequently miss out on successful innovations and improved performance. Firms need to: develop a clear policy of knowledge generation, identifying what knowledge is important for the organization and under what circumstances it should be disseminated; foster the transfer and integration of knowledge between workers, exploiting the interrelations between workgroups; and elaborate a knowledge map that determines in which people and systems the firm's accumulated knowledge base should reside.

Organizations should also be aware of the potential that IT has for favoring the development of more decentralized and flexible structures that ultimately facilitate the processes of knowledge generation and transformation. The existence of mechanisms that spread information throughout the whole firm helps decentralize decision-making power and initiative. This speeds up the decision-making, helps the firm exploit specific knowledge and ensures responsibility and commitment from the employees, who feel they have an important role in the company, as well as involved in its success. Substituting horizontal for vertical communication stimulates the exchange of information between employees and fosters the development of teamwork.

The analysis described here may provide some insight into the relations between information technology competency and knowledge management, but it suffers from some limitations.

Possibly the most important limitation is the fact that the study is a cross-section, especially considering that the firm's experience in IT may be an important element to measure the effectiveness of the competency. It would consequently be interesting to conduct a longitudinal study, taking measures at different points in time. This would allow the relations established in the theoretical model proposed here to be confirmed.

A second limitation concerns the fact that all data were collected from the key respondent. This is currently the standard methodology in strategy research but is known to suffer from certain drawbacks. The authors tried to correct these drawbacks by carefully selecting the respondents and cross-checking on their knowledgeability and involvement, but the drawbacks cannot be completely ruled out.

Finally, a third limitation concerns the fact that the study involves IT-intensive sectors. Future research is needed to determine if these results can be generalized to other industries.

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