Information Technology as an Enabler of Knowledge Management: An Empirical Analysis

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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 IT competency has a direct effect on the processes of knowledge management: knowledge generation, knowledge transfer, and knowledge codification and storage. At the same time, IT competency also has an indirect effect on knowledge management by facilitating the development of organizational structures that favor the development and expansion of knowledge. 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: Information Technology Competency, Organizational Learning, Knowledge Management

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; Davenport and Prusak, 1998).

In recent years, several researchers have associated knowledge management with the development of information and communication technologies, (ICT) (Ruggles, 1997; Scott, 2000; King, 2005). The new technologies are characterized by their capacity 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 ICT on economic-financial variables to studying its comple-

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mentarity 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 twofold: both direct and indirect. Information systems can directly influence the knowledge management processes. They can also indirectly influence knowledge management by affecting contextual factors such as structure, 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, structure 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

Defining the concept of knowledge management is not straightforward, because this subject has been studied by several disciplines and from different approaches. For example, Davenport et al. (1998) defines knowledge management as a process of collection, distribution and efficient use of the knowledge resource. O'Dell and Grayson (1998) see knowledge management as a strategy to be developed in a firm to ensure that knowledge reaches the right people at the right time, and that those people share and use the information to improve the organization's functioning. For Bhatt (2001), knowledge management is a process of knowledge creation, validation, presentation, distribution and application. And Bounfour (2003) defines knowledge management as a set of procedures, infrastructures, and technical and managerial tools, designed to create, share and leverage information and knowledge within and around organizations.

Although the above definitions vary in their description of knowledge management, 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 (Bueno and Ordoñez, 2004).

In the conceptual framework of this work, knowledge management is composed of three main processes, which are namely: knowledge generation, knowledge transfer, and knowledge codification and storage.

Knowledge generation can be defined as the process by which the firm obtains knowledge, either from outside the company or generated internally (Lee and Hong, 2002; McCann and Buckner, 2004). The objective is to obtain new and better knowledge that helps the organization improve its competitiveness (Wiig, 1997). 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). Firms can acquire knowledge externally from different sources, for example talking to external agents, collaborators and partners, buying patents or taking on new employees (McCann and Buckner, 2004). Internally, knowledge creation can involve developing new contents or replacing existing contents (Alavi and Leidner, 2001) by investing in R&D or training and development (McCann and Buckner, 2004).

Knowledge transfer refers to the process by which an organization shares knowledge among its units and members, promoting new understanding (Wiig, 1997; 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 (Lave and Wenger, 1991; Cook and Yanow, 1993; Brown and Duguid, 1998; Wenger, 1998; Fox, 2000; Gherardi and Nicolini, 2002).

Finally, knowledge codification and storage is a very important aspect in the effective management of knowledge (Levitt and March, 1988; Huber, 1991; Simon, 1991; Casey, 1997; Cross and Baird, 2000). The existing knowledge must be captured, codified, presented and put in stores in a structured way, so it can be reused later (Choi et al., 2008). However, it is vital to remember that organizational knowledge is dispersed and scattered throughout the organization. It is found in different locations, in people's minds, in organizational processes, and in the corporate culture, embedded in different artifacts and procedures, and stored in different mediums such as print, disk and optical media (Bhatt, 2001). Thus, some authors suggest that capturing, codifying and storing knowledge are the most challenging aspects of knowledge management.

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 (Maier et al., 1997).

Getting information is no longer the problem. The difficulty lies in obtaining quality information, where quality is measured in terms of accuracy, reliability, precision, and timeliness, and the extent to which the information is relevant in the decision making (Huber, 1990).

The IT revolution has facilitated the processes of searching for and recovering information, but at the same time it has led to an important growth in the database industry. Firms must be able to use IT to obtain useful information for their decision-making.

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 (Gunasekaran et al., 2001). This study differentiates between three dimensions of this concept: IT knowledge, IT operations, and IT infrastructure. These dimensions represent cospecialized resources that indicate the organization's capacity to understand and use the tools necessary for managing information about markets and customers (Tippins and Sohi, 2003). Moreover, although they are independent, all three aspects must be present for the firm to achieve IT competency. For example, many firms invest in technical tools but at the same time fail to achieve IT competency because they lack the knowledge required to use these tools efficiently. Brief definitions for these three dimensions follow.

IT knowledge. Knowledge is information combined with experience, context, interpretation and reflection, so knowledge has a tacit component that is difficult to quantify (Davenport et al., 1998). Taylor (1971) defines technical knowledge as the set of principles and techniques that are useful to bring about change toward desired ends. Thus, the current study defines IT knowledge as the extent to which the firm possesses a body of technical knowledge about elements such as computer systems.

IT operations. This concept refers to the IT-related methods, processes and techniques that may be needed if these technologies are to create value (Maier et al., 1997). In the context of the current study, IT operations is defined as the extent to which the firm uses IT to improve its effectiveness and decision making.

IT infrastructure. The IT infrastructure acts as an enabler, and to a large extent is responsible for the growing interest in the production and dissemination of information (Reardon et al., 1996). IT infrastructure refers to the 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

Information technology has been a central topic in the knowledge management literature (Stein and Zwass, 1995; Constant et al., 1996; Hayes and Walsham, 2003). Information and communication technologies have been closely associated with the development of the great majority of knowledge management initiatives. It is estimated that almost 70% of publications on knowledge management focus on the design of IT systems (Franco and Mariano, 2007).

The influence of IT competency on knowledge management can be considered two fold: direct and indirect. Information systems can directly influence the knowledge management processes. They can also indirectly influence knowledge management by affecting contextual factors such as structure, which, in turn, influence knowledge management. This section develops the hypotheses about the relations between IT competency and knowledge management.

4.1 IT Competency and Knowledge Management Processes

ICT improves the efficiency of organizational management processes and provides new ways of improving the capacity of response to environmental requirements. According to Olivera (2000), those technology systems serve a variety of functions such as storing large amounts of information, making information accessible to individuals, providing means of communication, generating records of interactions and transactions, and automating processes.

On the basis of the above reasoning, the influence of IT on the previously identified knowledge management processes (knowledge generation, knowledge transfer, and knowledge codification and storage) is now analyzed.

Strategic applications of information systems for knowledge generation can take two forms (Mason, 1993): capabilities for assimilating knowledge from outside (such as competitive intelligence systems acquiring information about other companies in the same industry); and capabilities for creating new knowledge from the reinterpretation and reformulation of existing and newly acquired information (such as executive information systems or decision-support systems).

Likewise, IT facilitates the process of knowledge transfer. Technology enables individuals to coordinate the logistics of face to face meetings. It can also be used to catalogue expertise of organizational members and a result facilitating access to the right people and enhancing 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 (Marwick, 2001; Lee and Choi, 2003). Exchange spaces become the ideal place to develop innovative and creative behaviors around problems and situations. One of the most important characteristics of these exchange spaces and virtual communities is that they are founded on the democratization of knowledge, so they enable the appearance of natural flows of transference and collaboration and consequently favor creativity and innovation (Narayanan, 2001).

Finally, IT supports the process of knowledge codification and storage. IT facilitates the standardization and automation of certain tasks, supporting the transformation of tacit knowledge into explicit knowledge (Anand et al., 1998). Similarly, IT also provides the necessary mechanisms to codify and store knowledge. In order to be useful, however, knowledge stores must be accessible to firm members and must be in a form that will enable each member to interpret in a similar manner, thereby becoming a part of the whole firm's knowledge base. IT, with its protocols and platform standards, provides an ideal mechanism for connecting widely dispersed individuals via a common system and enabling firm members to access more easily the knowledge that is stored in memory bins, so that new information can be interpreted and synthesized with existing knowledge (Tippins and Sohi, 2003).

Given this theoretical framework, the first three hypotheses are as follows:

H1. IT competency has a positive effect on the process of knowledge generation.
H2. IT competency has a positive effect on the process of knowledge transfer.
H3. IT competency has a positive effect on the process of knowledge codification and storage.

4.2 IT Competency, Structure, and Knowledge Management

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 organizational forms, which go under a large number of names. Clearly, a relation exists between the appearance of new organizational forms and technological development, and these technologies are considered the causes of the structural changes and of the emergence of new, more flexible organizational forms capable of rapidly and effectively adapting to the growing changes in the environment (Barley, 1990; Malone, 1997; Robey et al., 2000).

IT moderates vertical differentiation and allows fewer levels in the hierarchy to handle as much or more problem solving and decision making, resulting in a flatter organization (Dewett and Jones, 2001).

IT systems, by increasing the level of formalization or allowing "controlled" decentralization, can substitute for the control typically provided by the hierarchy (Keen, 1990). In addition, since IT provides low-level employees with more freedom to coordinate their actions, employees can experiment and find better ways to perform their tasks (Huber, 1990; Malone, 1997).

Consequently, the link between IT, organizational structure and knowledge management is evident. To the extent that IT has led to a reduction in the traditional boundaries between hierarchical levels (vertical boundaries) and between functions (horizontal boundaries), these technologies favor the development of organic structures where information, ideas and knowledge can flow rapidly through the organization and hence improve the chances of processing and generating knowledge effectively.

On the basis of the above arguments, the fourth hypothesis is as follows:

H4. IT competency has an indirect effect on knowledge management through its positive effect on new, more flexible organizational forms.

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 (Fundación BBVA, 2007). 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 1,660 firms from the SABI database satisfying the following requisites: belonging to one of the aforementioned 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. This study follows the recommendation of the European Commission 2003/361/EC, which defines the following types of firm: microenterprise, one with fewer than ten workers and not exceeding €2 million annual turnover; small enterprise, firm with fewer than 50 workers and an annual turnover of less than €10 million, medium-sized enterprise, firm with fewer than 250 workers and an annual turnover of less than €50 million, and large enterprise, firm with more than 250 workers and an annual turnover exceeding €50 million.

The data collection period was January to June 2007, and involved a postal survey. The sampling unit chosen was the CEO, 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 organized as follows: first, the research instrument was pretested twice. The draft version was pretested with the CEOs from four companies.

A second pretest was conducted after in-depth discussions with academics and questionnaire design experts. This second pretest involved seven firms. After some minor modifications, the final questionnaire was mailed to CEOs together with a letter explaining the purpose of the study and assuring anonymity. Further, given the low response rates associated with organizational research, the respondents were promised a complementary summary of the results. Six weeks after the initial contact, the authors sent a follow-up mailing including the same material as the first.

The number of valid questionnaires returned is 162, which represents a response rate of 9.75%. This rate is not as high as in US or UK studies, but nor is it out of line with comparable survey-based studies in Spain, such as López et al. (2006) and Prieto and Revilla (2006), whose response rates are 7.8 and 10.52, respectively.

To check the representativeness of the sample, the sample and the population were compared in terms of two criteria: the company size (considering four levels: between 50 and 200 employees, between 200 and 1,000 employees, between 1,000 and 5,000 employees, and over 5,000 employees) and the sector of activity (differentiating between industrial, financial and nonfinancial 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 nonresponse bias is not a serious issue in this study.

5.2 Measures

This section describes the scales used to measure IT competency, knowledge management and organizational structure (see also Appendix). All the variables were measured on Likert 5-point scales ranging from 1 = strongly disagree to 5 = strongly agree.

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. Items about the firm's knowledge, skills and experience in the use of IT measure the first of these dimensions. For the second dimension, the items measure the use of collaboration technologies, as well as the tools and systems available in the firm to acquire and store information that is useful in the decision making. Finally, to evaluate the firm's infrastructure, the scale includes items considering 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.

Knowledge management. Respondents were asked to indicate the level of agreement on each of the 11 items measuring various aspects of knowledge management processes including knowledge generation, knowledge transfer and sharing, and knowledge codification and storage. The scale 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 pretesting phase of the questionnaire development.

Organizational structure. To measure this construct, the authors selected four items evaluating organizations' degree of centralization, complexity and vertical differentiation that are adapted from Pugh et al. (1969) and Miller (1987).

6 Analysis and Results

6.1 Psychometric Properties of Measurement Scales

The psychometric properties of the measurement scales were assessed following accepted practices (Gerbing and Anderson, 1988). This included establishment of content validity and construct validity (see Table 1 for means, standard deviations, and factor correlations). Content validity was established through personal interviews with academics and chief executives during the pretesting phase of questionnaire development. Moreover, considerable efforts were made during the field-based validation to ensure that the scale items were relevant and generalizable across the industries in the sample. After an initial examination procedure that sought to identify items exhibiting low item-to-construct correlation or items loading significantly to more than one construct dimension, the authors 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, namely reliability, convergent validity, discriminant validity and dimensionality.

To assess scale reliability, the composite reliability estimates were calculated (Fornell and Larcker, 1981). These are directly analogous to the commonly used coefficient alpha statistics. As Table 1 shows, all measures have a composite reliability greater than the recommended level of 0.7 (Bagozzi and Yi, 1988). Establishing convergent validity requires examining the significance of the factor loadings (Gerbing and Anderson, 1988). As Table 2 shows, all the loadings of the measurement items on the hypothesized construct are significant ($p < 0.001$), which provides evidence of convergent validity. Discriminant validity was assessed by comparing the χ^2 differences between a constrained confirmatory factor model (where the interfactor correlation is set to 1, indicating they are the same construct) and an unconstrained model (where the interfactor correlation is free). As Table 3 shows, all χ^2 differences are significant, providing evidence of discriminant validity (Gerbing and Anderson, 1988).

To confirm the dimensionality of the higher-order constructs – IT competency and knowledge management – the authors ran second-order confirmatory factor analyses. Table 2 shows the results for the estimated models. The factor loadings of the first-order factors (IT knowledge, IT operations, and IT infrastructure) on the second-order factor IT competency are all significant at the $p < 0.001$ level. Similarly, the factor loadings of knowledge generation, transfer, and codification and storage on knowledge management are also significant. Further, the comparative fit index (CFI) exceeds the recommended norm of 0.9 for both the models (CFI = 0.962 for IT competency and 0.969 for knowledge management). This indicates good model fits and confirms the scale dimensionality.

Table 1: Factor Correlations, Means, Standard Deviations, and Reliabilities

	Mean	SD	Reliability	IT know.	IT ops.	IT inf.	K. gen.	K. tran.	K. stor.	Struct.
IT know.	3.887	0.845	0.920	1.000						
IT ops.	3.757	0.826	0.803	0.668	1.000					
IT inf.	4.102	0.945	0.877	0.652	0.551	1.000				
K. gen.	3.601	0.760	0.819	0.296	0.489	0.211	1.000			
K. trans.	3.698	0.734	0.836	0.349	0.373	0.284	0.594	1.000		
K. stor.	3.706	0.732	0.740	0.347	0.443	0.359	0.436	0.338	1.000	
Struct.	3.694	0.808	0.886	0.311	0.351	0.291	0.570	0.565	0.337	1.000

Table 2: Convergent Validity and Dimensionality Tests

Measures	Factor loadings (*t* value)
IT competency[a]	
First-order measurement model	
V1←IT Know.	0.83 (13.851)
V2←IT Know.	0.92 (18.437)
V3←IT Know.	0.92 (15.704)
V4←IT Ops.	0.84 (12.971)
V5←IT Ops.	0.81 (13.965)
V6←IT Ops.	0.56 (6.853)
V7←IT Ops.	0.61 (8.123)
V8←IT Inf.	0.91 (12.113)
V9←IT Inf.	0.86 (11.219)
V10←IT Inf.	0.79 (10.204)
V11←IT Inf.	0.62 (8.965)
Second-order factor model	
IT Know.←IT Competency	0.89 (11.098)
IT Ops.←IT Competency	0.89 (10.335)
IT Inf.←IT Competency	0.72 (7.235)
Knowledge management[b]	
First-order measurement model	
V12←K. Gen.	0.68 (9.987)
V13←K. Gen.	0.79 (11.353)
V14←K. Gen.	0.74 (9.223)
V15←K. Gen.	0.70 (9.492)
V16←K. Trans.	0.68 (7.446)
V17←K. Trans.	0.77 (8.274)
V18←K. Trans.	0.78 (9.967)
V19←K. Trans.	0.76 (10.691)
V20←K. Stor.	0.62 (7.337)
V21←K. Stor.	0.77 (9.205)
V22←K. Stor.	0.70 (7.475)
Second-order factor model	
K. Gen.←Knowledge Management	0.87 (8.673)
K. Trans.←Knowledge Management	0.82 (5.432)
K. Stor.←Knowledge Management	0.59 (4.192)
Structure[c]	
First-order measurement model	
V23←Structure	0.80 (10.304)
V24←Structure	0.87 (12.017)
V25←Structure	0.78 (9.928)
V26←Structure	0.80 (10.625)

(continued)

Table 2: (continued)

[a]Model summary statistics:
First-order model: S-Bχ^2=69.7816, d.f.=41 (p=0.003); RMSR=0.066; NNFI=0.952; CFI=0.964;
Second-order model: S-Bχ^2 = 72.5315, d.f.=42 (p=0.002); RMSR=0.067; NNFI=0.951; CFI=0.962
[b]Model summary statistics:
First-order model: S-Bχ^2=51.4367, d.f.=41 (p<0.001); RMSR=0.044; NNFI=0.961; CFI=0.971;
Second-order model: S-Bχ^2=52.6089, d.f.=42 (p<0.001); RMSR=0.047; NNFI =0.96; CFI=0.969
[c]Model summary statistics: S-Bχ^2=7.3103, d.f.=2 (p=0.025); RMSR=0.025; NNFI =0.945; CFI=0.982

Table 3: Discriminant Validity Test

	Correlation coefficients	
IT competency		χ^2 (d.f.=42)
IT know. – IT ops.	0.79	138.184 (p*<0.001)
IT know. – IT inf.	0.67	227.061 (p<0.001)
IT ops. – IT inf.	0.60	181.761 (p<0.001)
Base model (unconstrained)		χ^2=79.20 (d.f.=41)
Knowledge management		χ^2 (d.f.=42)
K. gen. – K. trans.	0.72	121.100 (p<0.001)
K. gen. – K. stor.	0.56	120.670 (p<0.001)
K. trans. – K. stor.	0.42	139.393 (p<0.001)
Base model (unconstrained)		χ^2=60.69 (d.f.=41)

*Denotes significance of χ^2 differences between constrained and unconstrained model

6.2 Hypothesis Tests

To test the hypotheses proposed in the theoretical section of this study two structural equation models were estimated using the statistics package EQS Version 6.1. The first relates IT competency with the 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 standardized path coefficients (β) and the t values.

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 RMSR. Their values are in all cases at acceptable levels.

The results provide clear support for hypotheses H1, H2, and H3. The findings show that IT competency has a positive effect on knowledge generation (β=0.3, t=4.107, p<0.01), knowledge transfer (β=0.28, t=3.611, p<0.01), and knowledge codification and storage (β=0.3, t=4.258, p<0.01).

To test the fourth hypothesis, the authors estimated a model relating IT competency with the organizational structure and knowledge management considered globally. Figure 2 shows the

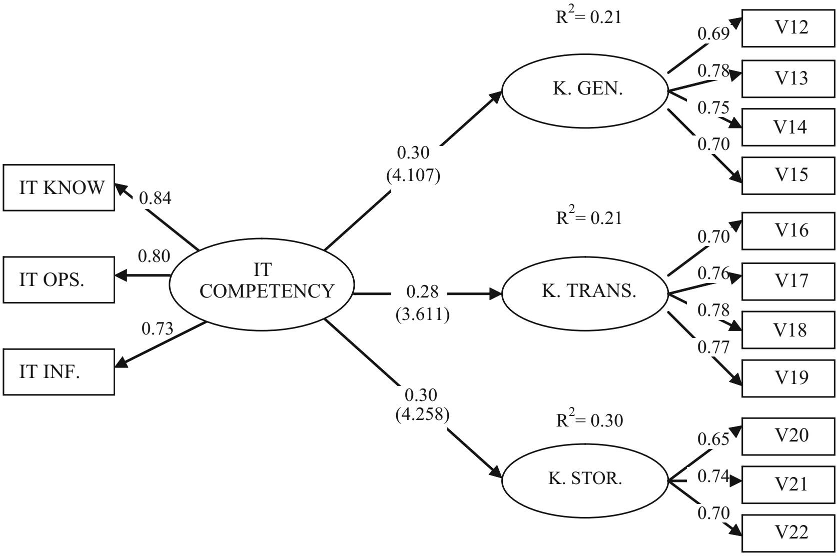

Fig. 1: Representative Model of Relations Between IT Competency and Knowledge Management Processes (*Notes*. Relation diagram shows standardized parameters; *t* value in parentheses; Model summary statistics: S-Bχ^2 = 126.082, d.f. = 71, p = 0.000; RMSR = 0.054; NNFI = 0.925; CFI = 0.941)

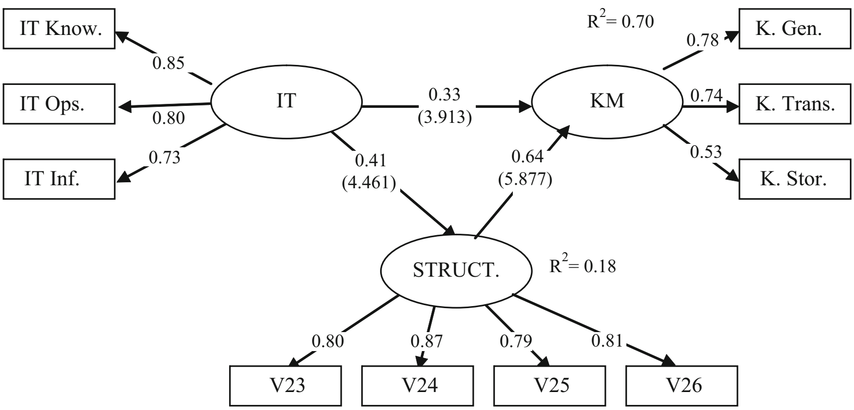

Fig. 2: Representative Model of Relations Between IT Competency, Structure, and Knowledge Management (*Notes*. Relation diagram shows standardized parameters; *t* value in parentheses; Model summary statistics: S-Bχ^2 = 56.7132, d.f. = 32, p = 0.004; RMSR = 0.054; NNFI = 0.939; CFI = 0.957)

results of this structural equations modeling analysis. As in the previous model, the Satorra–Bentler statistic is significant, but other relevant fit indices suggest that this model has a good overall fit. The results support our fourth research hypothesis.

First, IT competency evidently has a significant effect on the organizational structure, favoring the development of flatter, more-flexible structures ($\beta = 0.41$, $t = 4.461$, $p < 0.01$). Second, a significant, positive relation exists between this type of structure and the firm's capacity to manage knowledge, thereby supporting Hypothesis 4 ($\beta = 0.64$, $t = 5.877$, $p < 0.01$). Finally, a direct, significant relation exists between IT competency and knowledge management considered globally ($\beta = 0.33$, $t = 3.913$, $p < 0.01$).

Thus, and as initially hypothesized in this paper, IT competency has a direct effect on knowledge management, and also an indirect effect through the organizational structure.

7 Discussion

The emergence of the knowledge management concept is motivating, particularly in organizations with a certain complexity, some concern to invest in initiatives that help the firm to share and develop its organizational knowledge. This explains the growing recent interest among both academics and company managers in analyzing IT.

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.

First, the literature generally recognizes that IT has a positive effect on knowledge management, but researchers do not empirically analyze how IT affects each of the individual processes (knowledge generation, knowledge transfer, and knowledge codification and storage). One of the main contributions of the current work has been to analyze the impact of IT on these three knowledge management processes. The results of the empirical test of the model help to clarify the role that IT plays in knowledge management considered globally, and even more importantly, in each of its constituent processes. Although most studies stress the importance of IT in knowledge transfer and storage, and rather less its importance for knowledge acquisition, the results here make it clear that IT has an important role in all three processes: generation, transfer and codification and storage.

Second, previous studies do not empirically analyze the indirect relation between IT and knowledge management. The current work analyzes how IT indirectly influences knowledge management by affecting contextual factors, such as structure, which, in turn, influence knowledge management. The introduction of information systems flattens the structure of the organization and promotes greater dissemination of information to all individuals, which ultimately facilitates the different processes of generation and transformation of knowledge.

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 directly, favoring its processes, and indirectly, favoring the development of an organizational structure that in turn favors 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 ICT 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, and that time is needed for the consequences of learning to translate into improvements in performance. 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.

9 Appendix: Measurement Scale Items

IT competency	
IT knowledge	
V1	Overall, our technical support staff is knowledgeable when it comes to computer-based systems.
V2	Our firm possesses a high degree of computer-based technical expertise.
V3	We are very knowledgeable about new computer-based innovations.
IT operations	
V4	We routinely utilize computer-based systems to access information from outside databases.
V5	We use computer-based systems to analyze customer and market information.
V6	We utilize decision-support systems frequently when managing customer information.
V7	We have set procedures for collecting customer information from online sources.
IT infrastructure	
V8	Our company has a formal MIS department.
V9	Our firm employs a manager whose main duties include the management of our information technology.
V10	Our firm's members are linked by a computer network.
V11	Our firm creates customized software applications when the need arises.
Knowledge management	
Knowledge generation	
V12	We regularly meet with our customers to find out what their needs will be in the future.
V13	The company is in touch with professionals and expert technicians.

(continued)

Appendix (continued)

V14	We have a system that allows us to learn successful practices from other organizations.
V15	New ideas and approaches on work performance are experimented continuously.
Knowledge transfer	
V16	All members are informed about the aims of the company.
V17	Meetings are periodically held to inform all the employees about the latest innovations in the company.
V18	The company guarantees the sharing of best practices among the different fields of the activity.
V19	Teamwork is a very common practice in the company.
Knowledge codification and storage	
V20	Databases are always kept up to date.
V21	Employees often consult the databases.
V22	The codification and knowledge administration system makes work easier for the employees.
Structure	
V23	Organizational structure is flat.
V24	Departmental structure facilitates interaction between individuals and exchange of knowledge.
V25	Communication is fluid in both directions of hierarchical pyramid (horizontal and vertical).
V26	Decision making is decentralized.

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