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ORIGINAL PAPER

The influence of top management support for ICTs on organisational performance through knowledge acquisition, transfer, and utilisation

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Abstract This research analyses, first, whether top management support for information and communications technologies has positive consequences for knowledge management by analysing the specific influence of top management support for ICTs on each of the knowledge management processes (knowledge acquisition, transfer, and utilisation). Second, it analyses the influence of each knowledge management process on organisational performance. The theoretical model is tested using data collected from March to May 2010 from 201 CEOs in Spanish technology organisations. The results indicate that the stage-based disaggregation of the knowledge management process into knowledge acquisition, transfer, and utilisation, and the three-stage management process are the mediating mechanisms in the relationship between top management support for ICTs and organisational performance. CEOs should thus support the information and communication technologies necessary to improve all of the interrelated stages of knowledge management as a mechanism for achieving better organisational performance. Various strategic actions should be stimulated within the organisation to intensify the interrelation between these stages of acquisition, transfer, and utilisation of knowledge.

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1 Introduction

In recent years, organisations' interest in knowledge management has been growing, but when the specific definition of knowledge management is established, the concepts of information and knowledge are often used synonymously. We find two well-defined positions on this issue, one that views all information as knowledge and thus holds that more information necessarily implies more knowledge (Cowan et al. 2000), and another that stresses the differences between information and knowledge, describing knowledge production as a complex process that does not necessarily correspond to an increase in information (Davenport and Prusak 1998). The latter perspective is receiving more importance, as it suggests that knowledge is a cognitive capability associated with the possibility of interpreting and transforming information. Information, in contrast, is a set of data structured and formatted but inert and inactive unless interpreted by those who have the capabilities needed to manipulate them. "Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. In organizations, it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices, and norms" (Davenport and Prusak 1998, p. 5). Knowledge is simultaneously a flow and a formalized structure; it is intuitive and hard to capture in words or to understand fully in a logical way. Knowledge exists within people as part of human complexity. That is, knowledge involves internalised information properly integrated into a subject's cognitive structures.

Knowledge-based theory shows that knowledge-based resources are generally difficult to imitate and can produce a long-term sustainable competitive advantage if properly managed. The firm's capability to manage existing knowledge effectively and to create new knowledge constitutes the foundation for achieving sustainable competitive advantage over time (Alavi and Leidner 2001). Knowledge management thus consists of "the process of continually managing knowledge of all kinds to meet existing and emerging needs, to identify and exploit existing and acquired knowledge assets and to develop new opportunities" (Quintas et al. 1997, p. 387). Knowledge management "enables [the organisation] to create, exploit, renew and apply knowledge flows in new ways to create the essential competences for improvement of organizational performance" (Garcia Morales et al. 2008, p. 299). It permits "the identification, optimisation, and active management of intellectual assets to create value, increase productivity and gain and sustain competitive advantage" (Webb 1998, p. 37).

Various published studies to date stress that knowledge management is a multidimensional construct (Cohen and Levinthal 1990; Garcia Morales et al. 2008;

Quintas et al. 1997; Lane and Lubatkin 1998; Todorova and Durisin 2007; Webb 1998; Zahra and George 2002), although there is no consensus among researchers to establish the number of phases that compose the study construct. Authors like Zahra and George (2002), Jansen et al. (2005), and Todorova and Durisin (2007), for example, conceptualise the knowledge-processing process into four stages: acquisition, assimilation, transformation, and exploitation. Other authors, such as Cohen and Levinthal (1990, p. 128), define knowledge management as "an ability to recognize the value of new information, assimilate it, and apply it to commercial ends". Along these lines, Alavi and Leidner (2001, p. 55) analyse knowledge management as "the process of identifying, capturing, and utilizing the collective knowledge in an organization to help the organization compete". Darroch (2003, p. 41) defines it as "the process that creates or locates knowledge and manages the dissemination and use of knowledge within and between organizations". These definitions show knowledge management to be composed of three parts: knowledge acquisition, knowledge transfer or dissemination, and utilisation or use of knowledge. Further, each component of the knowledge management construct is presented as dependent on the other components. Firms with better-developed knowledge management routines are said to have a distinctive capability in knowledge management. Our study adopts this last perspective and analyses what is understood by each of the stages of the knowledge management process.

These three stages may be defined as follows. *Knowledge acquisition* is the initial stage of knowledge management. It involves the "processes oriented toward obtaining knowledge" (Hou and Chien 2010, p. 98), that is, all activities related to the search for, identification of, and access to new knowledge relevant to the firm (Alavi and Leidner 2001). The principal mechanisms for acquiring knowledge include hiring technical personnel, formal and informal collaboration, strategic alliances, and benchmarking (Davenport and Probst 2002). *Knowledge transfer* is "the process through which one unit (e.g., group, department, or division) is affected by the experience of another" (Argote and Ingram 2000, p. 151). Knowledge is transferred from the sender(s) (person, group, team, or organisation) to the recipient(s) (person, group, team, or organisation) (Albino et al. 2001), fostering the spread of know-how generated in one subunit to other parts of the organisation. It makes coordination of work faster and more precise by connecting multiple units that may be dispersed geographically, facilitates the coordination of work flows among subunits, and permits economies of scale (Schulz and Jobe 2001). Knowledge transfer requires a good communication structure, the involvement of the organisation's personnel, and the socialisation of knowledge (Argote and Ingram 2000; Nonaka and Takeuchi 1995). *Knowledge utilisation* is the application of the knowledge transferred among the different entities of the organisation to the receptor unit (Szulanski 2000). It involves the different processes oriented to the actual use of the knowledge after its transfer (Gold et al. 2001). Utilising knowledge permits members of the organisation to discount outdated knowledge, activate knowledge transfer, and incorporate knowledge in the organisation's products and services, generating greater added value for them (Bhatt 2001). While having a good stock of knowledge is important, the differences between organisations' performance lies less in the knowledge that they have than

in the application of this knowledge, that is, in the transformation of knowledge into action (Pfeffer and Sutton 1999).

Various studies have adopted a general perspective to analyse the influence on knowledge management of factors such as motivation, personal commitment, systems of rewards and incentives (Argote et al. 2003), communication and interaction between people in the firm (Nonaka and Takeuchi 1995), the existence of a culture of collaboration and teamwork (Walczak 2005) or technological innovation (e.g., Scheel 2002; Wang 2005). From a more specific perspective, some studies have focused on analysing how active commitment on the part of top management to strategic factors such as learning (O'Dell and Grayson 1998), innovation, or new product development (Brown and Eisenhardt 1995; Kleinschmidt and Cooper 1991; Maidique and Zirger 1985) encourages the success of knowledge management.

Various questions still require additional research, however. First, one cannot assume that top management's full support of these factors will guarantee immediate or long-term success in knowledge management, much less in each of the knowledge management processes. Further research has been recommended to demonstrate both theoretically and empirically this influence on the different processes taken individually (Ciborra and Hanseth 1998). Second, various studies show that little attention has been paid to the influence of top management support on organisational performance through the different stages of knowledge management. More research is required to show the specific influences of knowledge management processes on organisational performance (Bolivar Ramos et al. 2012; Martin Rojas et al. 2011; Salazar et al. 2003). Third, the capability to obtain information on markets or clients can improve the organisation's predisposition to adapt to changes in the environment and improve its competitive position with respect to competitors (Barney 1991). Companies should thus develop strategies that promote the use of ICTs (e.g., artificial intelligence, expert systems, database technology, knowledge-based systems, data mining, knowledge management frameworks, and modelling) to facilitate the acquisition, transfer, and use of information and knowledge (Alavi and Leidner 2001; Dougherty 1992; Mata et al. 1995; Tippins and Sohi 2003). In spite of the academic and practical interest in understanding how to maintain a competitive advantage (Pavlou and El Sawy 2006; Zhang et al. 2004), there is no clear knowledge of how top management support for ICT affects knowledge management processes and how these processes specifically contribute to improved performance (Devaraj and Kohli 2003; Lee et al. 2008).

This study seeks to respond to these questions. First, it analyses specifically whether top management support for ICTs has positive results for knowledge management, analysing theoretically and empirically the concrete influence of top management support for ICTs on each of the processes of knowledge management. Second, it deepens knowledge of the concrete influence of each knowledge management process on organisational performance. Third, we focus on top management support for ICTs. All of these knowledge variables demand strong and committed top management support to guide the initiative and develop a working environment that supports technology (Ghosh et al. 2001). Top management support "reflects, in many ways, the importance that top management executives place on technology" (Byrd and Davidson 2003, p. 246). For Leonard-Barton and

Deschamps (1988, p. 1254), top management support is a "perceived powerful source". Managers should understand company culture and values, and they should maintain what is good and promotes knowledge creation through a knowledge management process (Martin Rojas et al. 2011). This goal can be achieved if the manager is willing to observe and talk to employees, to recognise obstacles, problems and success, and to encourage teams and cross-functional cooperation and communication in the use of ICT (Garcia Rodriguez et al. 2008). Top management support also involves economic investment in acquiring new ICTs, as well as greater involvement in the learning of these ICTs (Bolivar Ramos et al. 2012; Martin Rojas et al. 2011). Top management support for ICTs enables the organisation to access, transmit, and use knowledge (Carlsson and El Sawy 2008; Lin 2007; Martin Rojas et al. 2011) by nurturing an environment more favourable to the acceptance and use of ICTs. Furthermore, the employees of firms that are implementing a technology-supportive culture are likely to have more precise knowledge of the organisational objectives for innovation and entrepreneurship and will make a greater effort to achieve these objectives more efficiently (Martin Rojas et al. 2011), as they have been trained through specific knowledge management processes provided by top management (Leonard-Barton and Deschamps 1988).

Our investigation draws on this context to propose an integrated model of the interaction and relationships among the constructs mentioned above within the framework of technology organisations. Technology organisations are firms that have a strong orientation to R&D, innovativeness, and entrepreneurship and that maintain a special pattern of work relations (a corporate culture of technology). These elements shape shared values, beliefs, and symbols, as well as the way things are done in the firm. We chose technology firms because of their current importance in modern economies, due to their contribution to economic growth, increase in productivity and creation of new, innovative industries, products, and processes (Grinstein and Goldman 2006). We also chose technology organisations because of the special importance of good knowledge management and ICT use in them (Bolivar Ramos et al. 2012; Hine et al. 2007; Liyanage and Barnard 2002; Martin Rojas et al. 2011; Salazar et al. 2003).

To achieve the objectives stated above, the investigation is structured as follows. The next section, Sect. 2, develops a foundation of prior research from which to propose a series of hypotheses. Section 3 presents the data and the research methodology used in the empirical analysis. Section 4 shows the results obtained. Finally, we present the discussion and conclusions, which include theoretical contributions and managerial implications, limitations, and future research directions.

2 Hypotheses

2.1 The influence of top management support for ICTs on knowledge acquisition, knowledge transfer, and knowledge utilisation

Top management support for ICTs is strategic in organisations, as it helps to achieve the acquisition, transfer, and utilisation of knowledge. It improves organisational

knowledge acquisition, fosters knowledge exchange, and contributes to solving problems (Davenport and Probst 2002; Reilly et al. 2003). Such support for ICTs from the organisation's top management promotes access to knowledge and its storage, retrieval, transfer, processing, and use among the organisation's members. These activities provide both the foundation for creating networks of knowledge available in the organisation and the knowledge necessary for decision making (Alavi and Leidner 2001; Nambisan 2003). Top management support for ICTs thus encourages processes of knowledge management (Huysman and Wulf 2006; Lin and Lee 2004).

If we focus specifically on the process of knowledge acquisition, we see that it can be strengthened by top management's support for ICTs (Collinson 2003; Kogut and Zander 1993). First, top management support for ICTs drives the use of communication mechanisms, such as email, chat, videoconferences, and Web-based information systems and intranet, as well as expert software systems that improve effectiveness in locating and identifying potentially useful knowledge (Alavi and Tiwana 2002; Pitt and MacVaugh 2008). These ICTs permit location of this strategic knowledge and its structuring for subsequent transfer and use by different members in the organisation (Nonaka and Takeuchi 1995; Prusak 1997; Zhang et al. 2004).

Second, top management support for ICTs enhances efficiency in accessing knowledge by improving individuals' absorptive capacity. An organisation's absorptive capacity depends on absorptive capacity at the individual level, although it is more than the sum of the absorptive capacity of its employees (Francalanci and Morabito 2008). It is improvement in the absorptive capacity of individuals that drives improvement in the access to and exploitation of new external knowledge (Malhotra et al. 2005; Zahra and George 2002). ICTs promote the individual capacity of the organisation's members to interact and thus to locate and acquire knowledge, fostering a culture open to the environment and to knowledge acquisition (Argote et al. 2003; McAfee 2006). This provides the medium for individuals in the firm to develop their capability to search for and acquire knowledge to solve complex problems from different perspectives (Boland et al. 1994). ICTs thus strengthen the interfunctional communication that facilitates the process by which absorption and transformation of knowledge occurs (Francalanci and Morabito 2008; Gattiker and Goodhue 2005; Zahra and George 2002).

Third, top management support for ICTs provides the resources needed for acquiring knowledge. In this sense, ICTs provide the means for increasing the acquisition, manipulation, control, and dissemination of information and knowledge (Kalusopa 2005). ICTs enable greater global circulation of information and knowledge and thus the overcoming of different prior constraints of time and distance that make it more difficult to acquire knowledge (Steinmueller 2001). The different ICTs constitute unprecedented potential new resources for organisations, resources that drive the acquisition of information and knowledge with greater precision at the right time through different mechanisms (e.g., Internet, social networks, etc.), fostering inter-organisational links that increase the organisation's value (Kalusopa 2005). Based on the foregoing, we propose the following hypothesis:

H1 Top management support for ICTs will be positively related to knowledge acquisition.

Top management support for ICTs also stimulates knowledge transfer in different ways. First, top management support for ICTs enables members to reduce the time and the physical and social barriers that impede knowledge exchange and transfer among members of the organisation. ICTs enable the reduction of barriers related to different time zones or languages that impede knowledge transfer (Bayar 1998). ICTs also counteract physical barriers that impede knowledge transfer with members located outside the organisation (e.g., clients, providers, the competition) or within it but in a different physical or geographical location (Hendriks 1999, 2001; Perez and Dressler 2007). For example, top managers can use ICTs in virtual meetings as a mechanism to transfer knowledge of specific topics or to show different points of view that enable the organisation to solve problems with its clients (Hendriks 1999). In this regard, social networks make it easier to overcome social barriers by implementing a culture of continuous and dynamic knowledge transfer (Perez and Dressler 2007).

Second, top management support for ICTs facilitates simultaneous and structured access to knowledge needed at the right time by different users (multi-user) as often as necessary (multi-occasion), as well as the transfer of knowledge in multiple formats in real or recorded time at a low cost. Organisations whose top management support electronic tools such as databases, multimedia systems, simulation software, knowledge portals, workflow, intranets, and forums foster the interaction between different users on different occasions, stimulating a culture of transfer of knowledge and ideas that facilitates simultaneous, structured access to the knowledge needed at each moment (Alavi and Leidner 2001; Benavides Velasco and Quintana Garcia 2005). Such organisations also reduce the cost of communication and knowledge transfer (Bayar 1998) and increase the frequency, volume, and efficacy of knowledge transfer, enabling transfers in multiple formats and times (Alavi and Leidner 2001; Perez and Dressler 2007).

Third, top management support for ICTs fosters the transfer of both explicit and tacit knowledge. ICTs support the presence of flows to exchange explicit and tacit knowledge, both directly and indirectly, through the existence of meetings and the generation of brainstorming phone calls, internet, email, videoconferences, etc. (Roberts 2000). Explicit knowledge transfer is easier than tacit because, among other reasons, explicit knowledge is articulated, codified, and structured. Tacit knowledge is strategic knowledge for the organisation, but it presents greater difficulties because it involves intangible personal beliefs and individual experiences (Nonaka and Takeuchi 1995). ICTs provide the mechanism necessary for contact among the organisation's members, which is usually a prerequisite for success in transferring this tacit and strategic knowledge (Bolisani and Scarso 2000; Roberts 2000). Based on the foregoing, we propose the following hypothesis:

H2 Top management support for ICTs will be positively related to knowledge transfer.

As to the influence of top management support for ICTs on knowledge utilisation, we first indicate that ICTs decrease the time and physical barriers that make knowledge utilisation difficult. One of the main obstacles to the effective utilisation of the organisation's knowledge is the absence of support from top management for ICTs (Storck and Hill 2000). Managerial support for using ICTs permits the reduction of physical barriers and provides the time needed to apply the knowledge previously acquired and transferred (Ferro et al. 2009). ICTs will enable faster access to the knowledge to be used, reducing the amount of obsolescent knowledge and allowing more efficient use of the different knowledge sources available through fast technological networks or applications (Lara and Duart 2005; Ng and Li 2003). In sum, ICTs improve the effective application of the information and knowledge available at the right time (Alavi and Leidner 2001; Badamas 2009; Bhatt 2001).

Second, top management support for ICTs facilitates knowledge utilisation and value creation for the organisation. Top management support for ICTs makes it easier for the organisation (1) to determine the products and services that each customer wants, as well as customer preferences, complaints, and tastes; (2) to establish systems with personalised content; and (3) to use this knowledge to develop products and services to meet customers' needs (Perez and Dressler 2007). Top management support for ICTs thus makes it easier to capture customer preferences continuously and to apply this knowledge to create value for the organisation (Hollenstein 2004), developing strategic actions (Badamas 2009; Bender and Fish 2000; Ferro et al. 2009) and improving the exploitation of corporate strategic assets (Bose 2002). ICTs promote knowledge utilisation and the generation of competitive advantage (Gilbert and Cordey-Hayes 1996; Martin Rojas et al. 2011; Robey et al. 2000). Further, top management support for ICTs such as e-commerce or customer relations management through the use of ICTs (e.g., Internet, social networks, information and communications systems) promotes the use of knowledge from new perspectives not possible a few years ago (Badamas 2009). Based on the foregoing, we advance the following hypothesis:

H3 Top management support for ICTs will be positively related to knowledge utilisation.

2.2 The influence of knowledge acquisition on knowledge transfer

Knowledge acquisition, transfer, and utilisation are interdependent and simultaneous processes of knowledge management developed by individuals, groups, and the organisation in general. Although these processes are closely interconnected, previous research recommends analysing the relationship between the acquisition and transfer of knowledge and between the transfer and use of knowledge (Alavi and Leidner 2001).

If we focus on the relationship between acquisition and transfer of knowledge, we can indicate, first, that organisations invest in acquiring knowledge through different activities and practices, such as hiring personnel or new engineers, reassigning workers in the firm, and ensuring that personnel participate in

continuing education programs or attend professional conferences. These practices encourage the acquisition of knowledge, which in turn enhances the process of knowledge exchange and transfer (Biskup and Simons 2004). Likewise, ICTs permit an increase in the acquisition of knowledge and its subsequent transfer, stimulating the creation of a field of interaction between the organisation's members, which facilitates the exchange of ideas, perspectives, and knowledge acquired (Henderson and Sussman 1997). The greater the knowledge acquired and the effort of acquisition, the greater the transfer of knowledge achieved (Darr et al. 1995). Boland et al. (1994) provides a specific example called Spider that creates an environment for organisational knowledge acquisition in the context of a planning task. Spider provides an environment for representing, exchanging, and debating different individual perspectives. The system simulates an extended field in which "assumptions are surfaced and questioned, new constructs emerge and dialog among different perspectives is supported" (Boland et al. 1994, p. 467). This procedure improves the quality and frequency of knowledge acquisition, driving knowledge transfer (Alavi and Leidner 2001).

Second, just as the benefits derived from the acquisition of knowledge at a given time depend on the prior level of knowledge of personnel or equipment, the effectiveness of the transfer of knowledge at a given time also depends on the levels of knowledge acquired by both sender and receiver (Darr et al. 1995; Epple et al. 1996). For example, a team for the design of processes that has acquired a high level of knowledge can transfer more knowledge to the team designing the product. Likewise, the product design team is more willing to receive knowledge from a process design team if it perceives that this team has acquired a high level of knowledge (Jacobs 2006). Different empirical studies show that the efficacy of the knowledge transfer is related to the degree of effort invested, as well as the levels of knowledge acquired by the personnel or teams who participate in the transfer (Argote and Ingram 2000; Cummings and Teng 2003). Based on the foregoing, we propose the following hypothesis:

H4 Knowledge acquisition will be positively related to knowledge transfer.

2.3 The influence of knowledge transfer on knowledge utilisation

Knowledge transfer and knowledge utilisation are closely related, with knowledge transfer generally producing a positive effect on knowledge utilisation (Alavi and Leidner 2001; Szulanski 1996). First, knowledge transfer between the organisation's different areas and specialised personnel promotes the use of knowledge needed to produce goods and services that require a combination of many areas of specialised knowledge (Demsetz 1991; Grant 1996). The higher the number of knowledge transfers, from different qualified and prepared sources, the greater and more efficient the organisation's use of knowledge will be (Ridding and Catterall 1998).

Second, rapid, precise knowledge transfer increases the organisation's capability to use this knowledge with greater speed when there are business opportunities (Jantunen 2005). Knowledge can mean different things for different members of the organisation, and not transferring precise knowledge at the right moment can mean

rejection of a product or failure to resolve the problem at hand. Thus, a critical element for success in the use of knowledge is that the knowledge or precise information be directed to the fundamental question in an easy and concise way, so that the individual or organisation can use it at the right moment, adjusting the new knowledge to its existing knowledge and experience (Boer et al. 2011; Hutchinson and Huberman 1993). Such knowledge transfer permits better use of knowledge and the processes and products developed (Jantunen 2005).

Third and finally, the greater the intensity of the union between knowledge transfer and use, the greater the quality and relevance of the knowledge used. The user is not merely a passive receptacle of information and expertise but an active problem-solver and constructor of his/her own knowledge. Involving potential users of the knowledge in the process of knowledge transfer increases and improves use of the knowledge (Hutchinson and Huberman 1993). Based on the foregoing, we propose the following hypothesis:

H5 Knowledge transfer will be positively related to knowledge utilisation.

2.4 The influence of knowledge acquisition, knowledge transfer, and knowledge utilisation on organisational performance

The resource-based theory argues that firms that possess valuable and rare resources and assets can achieve competitive advantage and superior long-term performance. This advantage can be sustained over longer time periods if the firm is able to protect itself against imitation, transfer, and substitution of these resources (Barney 1991; Galunic and Rodan 1998). Among such resources and assets, knowledge is crucial for achieving competitive advantage and improving organisational performance (Teece et al. 1997). It is therefore important that knowledge be managed properly in its main stages of acquisition, transfer, and utilisation (Nonaka and Takeuchi 1995). These stages are interrelated, such that a benefit in one of the stages leads to improvement in the others and also in organisational performance (Lee and Yang 2000).

Various studies that focus specifically on the process of knowledge acquisition demonstrate a positive relation between knowledge acquisition and organisational performance (Inkpen 1998; Inkpen and Beamish 1997). Lyles and Salk (1996) show how the process of knowledge acquisition and the characteristics through which knowledge acquisition is developed (active participation of the organisation's members, learning capacity, organisational structure, conflicts and differences between the members, etc.) help to promote the adaptation and creation of competitive advantages, increasing organisational performance. Likewise, in their analysis of 135 Hungarian multinational firms, Steensma and Lyles (2000) indicate that knowledge acquisition has a significant and positive impact on the firm's overall performance through its improvement of employees' competences. Knowledge acquisition not only helps to provide a vision of new business transactions, development of new products, and improvement in different forms of production but also influences the development of new systems and structures that improve

organisational performance (Si and Bruton 2005). Based on the foregoing, we propose the following hypothesis:

H6 Knowledge acquisition will be positively related to organisational performance.

A variety of research argues for a positive relationship between knowledge transfer and organisational performance (e.g., Bresman et al. 1999; Davenport and Prusak 1998). Knowledge transfer among the organisation's members favours the implementation of more flexible production processes, reduces the likelihood of repeating errors (contributing to reducing the firm's overall costs), and improves organisational performance (Alavi 2000; Puck et al. 2006). Knowledge transfer among the organisation's members also stimulates innovation, mutual learning, and cooperation and coordination, increasing organisational performance (Grant 1996; Nonaka et al. 2000; Tsai 2001). The existence of a greater knowledge base due to the transfer of knowledge thus makes the firm's activities more difficult to imitate, increasing its chances of obtaining a competitive advantage (Schulz and Jobe 2001).

It follows that knowledge transfer among organisational units also enables the connection and coordination of different units that are geographically distant and separated from each other, improving organisational performance (Argote et al. 1990; Baum and Ingram 1998). O'Dell and Grayson (1998) demonstrate these benefits in their analysis of the effects of the transfer of knowledge among the units of the firm Texas Instruments. This organisation generated 150 million dollars in manufacturing capacity for silicon memory chips by transferring and sharing knowledge among its thirteen manufacturing plants. Similarly, in the Chevron network, 100 people who transferred knowledge about managing energy use generated an initial savings of 150 million dollars for the organisation.

In short, knowledge transfer influences organisational performance positively by enabling the replacement of inefficient practices with other practices that have demonstrated greater efficiency, replicating best practices throughout the organisation, and identifying and exploiting economies of scale and scope related to knowledge (Schulz and Jobe 2001; Szulanski 1996). Based on the foregoing, we propose the following hypothesis:

H7 Knowledge transfer will be positively related to organisational performance.

The utilisation of knowledge acquired and transferred is crucial for survival, success, and performance of the organisation (Grant 1996; Spender 1994). A large portion of the benefits firms obtain comes from utilisation of this knowledge (Liebeskind 1996) to achieve products with lower costs and higher profit margins for the firm (Nonaka 1994). Thus, organisations generate new knowledge at a lower cost and faster than competitors. The dynamic capability to use new knowledge efficiently enables them to improve their organisational performance (Cohen and Levinthal 1990; Dröge et al. 2003; Zahra and George 2002). In other words, organisations that use available knowledge and incorporate it into their production processes are better able to exploit existing opportunities in the market, improving their processes, products, and organisational performance (Jantunen 2005). In today's turbulent and uncertain markets, not using the knowledge transferred will

make it harder to create market value and obtain competitive organisational advantage (Teece 1998; Wiig 1997).

Different studies have demonstrated this positive relation between knowledge utilisation and organisational performance. Claycomb et al. (2002) indicate that the use of knowledge promotes improvement in entrepreneurial and organisational performance. Gold et al. (2001) demonstrate a positive relationship between the use of knowledge and the firm's efficacy. Along similar lines, Siekman (2002) analyses how the use of the knowledge acquired and transferred in the product supply chain leads to more efficient processes and lower cost of the design and its manufacture, as well as a decrease in the time between the process launch and first delivery of the product to customers. Other authors show that the use of knowledge previously acquired, classified, ordered, and codified allows the organisation to reduce costs, not only in monetary terms but also in terms of time, achieving a faster competitive response to changes in the market (Haas and Hansen 2005; Yan and Zhang 2003). Sarin and McDermott (2003) show that fostering organisational learning enables members and teams in the organisation to apply the knowledge acquired and transferred to develop new products and improve the organisational performance. Based on the foregoing, we propose the following hypothesis:

H8 Knowledge utilisation will be positively related to organisational performance.

3 Research methodology

This section presents the research methodology used in this study. We first describe the sample used and then discuss how each of the variables included in the study is operationalised. Finally, we present the statistical analysis. We used structural equation modelling (SEM), a statistical technique for testing and estimating causal relations from a combination of statistical data and qualitative causal assumptions. SEM enables one to propose the type and direction of the relationships one expects to find among the various variables contained in the model in order then to estimate the parameters specified by the relationships proposed on the theoretical level. This technique has an advantage over other statistical methodologies in that the interdependence of the variables enables one to decompose the total direct effects into direct and indirect effects and to test for the goodness of fit of the model as a whole. Further, SEM is very useful in comparing alternative (competing) models, since it enables the use of latent variables and the consideration of measurement error which, with the variation in the values of the goodness of fit indices, can indicate the existence of improved alternative models (Hair et al. 2010). We chose SEM for its different advantages and because it is the technique used in almost all fields of study for investigations like the one performed in this paper.

3.1 Sample and procedure

The first step in an empirical study is selecting the population to be analysed. The population for this study consists of technology organisations in Spain. We chose

technology organisations due to the interest inherent in studying technology and knowledge in sectors with a substantial technological component. Technology organisations are potential vehicles for transferring knowledge from the academic environment to the production sector and are strategic for the economy (Fontes 2001, 2005). Technology organisations are organisations that emphasise an orientation to R&D, innovativeness, and entrepreneurship and that maintain a special pattern of work relations (a corporate culture of technology). These elements describe shared values, beliefs, and symbols, as well as the way things are done in the firm (Grinstein and Goldman 2006). The sample was selected by means of stratified sampling with proportional allocation (size and geographical location) from the database Dun and Bradstreet Spain (2003). We selected the technology organisations based on the International Standard Industrial Classification (ISIC). Choosing a sample of firms located in a relatively homogeneous geographical, cultural, legal, and political space enables us to minimise the impact of the variables that cannot be controlled in the empirical research (Adler 1983; Hofstede 1980). The Spanish market is relatively well developed and wholly integrated in the European Union. However, Spain is in a geographical area that has received relatively little attention from organisational researchers.

Drawing on our knowledge about the stages in the knowledge management process (acquisition, transfer, and utilisation) and top management support for ICTs, previous contacts with interested managers and scholars, and new interviews with managers and academics interested in these strategic variables, we developed a structured questionnaire to perform this investigation. We then established a reliable list of the CEOs of the organisations, with the help of partial funding from the Spanish Ministry of Science and Research and the Council for Economics, Innovation, and Science of the Andalusian Regional Government. We omitted the responses of the interviewees in this first stage from the subsequent analysis of the survey data.

We decided to use CEOs as our key informants, since they receive information from a wide range of departments and are therefore a very valuable source for evaluating the different variables of the organisation. They also play a major role in informing and moulding the variables under study by determining the types of behaviour that are expected and supported (Baer and Frese 2003). The same types of informant were chosen, since this means that the level of influence among the organisations is constant, increasing the validity of the variables' measurements (Glick 1985).

Surveys were mailed to the 900 selected organisations along with a cover letter in March 2010. We used this method because it enabled us to reach a greater number of organisations at a lower cost, to exert less pressure for immediate reply, and to provide the interviewees with a greater sense of autonomy. The cover letter explained the goal of the study and offered recipients the option of receiving the results once the study was completed. To reduce possible desirability bias, we promised to keep all individual responses completely confidential and confirmed that our analysis would be restricted to an aggregate level that would prevent the identification of any organisation. We told respondents that they would soon receive

the questionnaire and reiterated the necessity that the person chosen answer it, even at the cost of receiving fewer responses.

We mailed each manager who had not yet responded two reminders. The questionnaires were received during the months of March, April, and May 2010. The respondents were given the option of contacting us with queries, suggestions, or recommendations. 201 valid questionnaires without missing values were returned. The response rate was 22.33 % (Table 1). We checked for the possibility of non-response bias by comparing the characteristics of the responding businesses with those of the non-responding businesses. Our analysis indicated that respondents did not differ significantly from non-respondents with respect to return on assets, return on equity, return on sales, or number of employees. We also checked the representativeness of the final sample in comparison with the whole population of Spanish technology organisations relative to different variables, such as size (e.g., number of employees, income, turnover), type of firm according to the ISIC, and geographical location in Spain. We do not find any significant differences. Finally, we found no significant differences between early and late respondents (Armstrong and Overton 1977). Since all measures were collected with the same survey instrument, the possibility of common method bias exists. The authors were aware of this possibility and used several procedures to examine the possibility that common method bias threatened the interpretation of the results. First, Podsakoff et al. (2003) provide guidance to reduce common-source bias in this regard, stressing two key goals: (a) to ensure anonymity in survey administration; and (b) to improve items used to measure constructs. The study followed both recommendations. By clearly communicating study goals and assuring respondents of the survey's anonymity, the investigation meets a key recommendation of Podsakoff et al. (2003), that well-tested and -validated scales reduce item ambiguity. In measuring study constructs, the research also relies on previously tested scales. Finally, the research randomised the order of presentation of the survey items across the subjects. These steps together minimise common method bias (Pandey et al. 2008). Second, the investigation tested for the possibility of common method bias using Harman's one-factor test (Konrad and Linnehan 1995; Podsakoff and Organ 1986). The rationale for the first test was that, if common method bias poses a

Table 1 Technical details of the research

Sectors	High-tech services and high tech manufacturing
Geographical location	Spain
Methodology	Structured questionnaire
Procedure	Stratified sample with proportional allocation (size)
Universe of population	50,000 firms
Sample (response) size	900 (201) firms
Sample error	3.3 %
Confidence level	95 %, $p - q = 0.50$; $z = 1.96$
Period of data collection	From March 2010 to May 2010

serious threat, a single latent factor would account for all manifest variables or one general factor would account for most of the covariance among the measurements. In this investigation, the factor model obtained using principal components analysis yielded several factors with eigen-values greater than 1.0, which accounted for 70 % of the total variance. A substantial amount of method variance does not appear to be present, since several factors—not just one single factor—were identified, and because the first factor did not account for the majority of the variance. The percentage of the variance explained by the first factor is 18.66 %, which shows that common method bias is not a major threat in the data set (Podsakoff and Organ 1986). Third, more recently some researchers have used confirmatory factor analysis (CFA) as a more sophisticated method to test for common method bias. A worse fit for the one-factor model would suggest that common method variance does not pose a serious threat. In our case, the fit was worse for the one-dimensional model than for the measurement model, suggesting that common method bias was not a serious threat. Fourth, another approach used involves adding a first-order factor with all of the measures as indicators to the researcher's theoretical model. When comparing indicator loadings before and after adding the common latent factor, we found no differences greater than 0.200, so common method bias was not a major threat in our data set (Podsakoff et al. 2003).

3.2 Measures

The use of constructs has played an important role in designing survey instruments in management research. In any research concerning behavioural elements, no device using a single metric unit can measure precisely, and researchers usually employ two or more measures to gauge a construct or scale. Given that developing new constructs or scales of measurement is a complex task, wherever possible we used pre-tested constructs from past empirical studies to ensure their validity and reliability.

3.2.1 Top management support for ICTs

Various studies have measured top management support and top management support for ICTs. Due to the fact that there is a closer link with our research, that they reflect the different prior trends well, and that the scale's validity was verified in detail, we used the scale developed by Byrd and Davidson (2003). These items were duly adapted to the present study (see "Appendix"). We developed a confirmatory factor analysis to validate the Likert-type 7-point scale (1 "totally disagree", 7 "totally agree") of three items and showed that the scale was one-dimensional and had good validity and reliability ($\alpha = .871$).

3.2.2 Knowledge acquisition

Based on work presented by Darroch (2003) and Yli-Renko et al. (2001), we developed a Likert-type 7-point scale (1 "totally disagree", 7 "totally agree") of eight items. We performed a confirmatory factor analysis to validate our scales,

which required deletion of Items 1, 2, 5, and 6 ($\chi^2_2 = 4.84$, Normed Fit Index [NFI] = .99, Non-Normed Fit Index [NNFI] = .98, Goodness of Fit Index [GFI] = .99, Comparative Fit Index [CFI] = .99, Incremental Fit Index [IFI] = .99). The scale was one-dimensional. The procedure allowed us to choose four items (see "Appendix") with high validity and reliability ($\alpha = .843$).

3.2.3 Knowledge transfer

Due to the fact that there is a closer link with our research and that the scale's validity had been verified in detail, we used a Likert-type 7-point scale (1 "never", 7 "to a great extent") with four items from the scale developed by Cummings (2001) and Molina et al. (2007). These items were duly adapted to the present study (see "Appendix"). We developed a confirmatory factor analysis to validate our scales ($\chi^2_5 = 7.70$, NFI = .98, NNFI = .99, GFI = .99, CFI = .99, IFI = .99) and showed that the scale was one-dimensional and had good validity and reliability ($\alpha = .876$).

3.2.4 Knowledge utilisation

Based on work by Alavi and Leidner (2001) and Lee et al. (2005), we developed a Likert-type 7-point scale (1 "totally disagree", 7 "totally agree") of four items (see "Appendix"). Using a confirmatory factor analysis, we validated our scale ($\chi^2_2 = 19.15$, NFI = .99, NNFI = .99, GFI = .99, CFI = .99, IFI = .99) and then verified the scale's one-dimensionality and its validity and reliability ($\alpha = .903$).

3.2.5 Organisational performance

Having reviewed how performance is measured in different works of strategic research, we drew up a scale that included six items to measure organisational performance (see "Appendix"). The use of scales for evaluating performance in comparison with the main competitors is one of the most widespread practices in recent studies (Douglas and Judge 2001; Garcia Morales et al. 2008; Vorhies et al. 1999). Various researchers have used managers' subjective perceptions to measure beneficial outcomes for firms. Others have preferred objective data, such as return on assets. The literature has widely established high correlation and concurrent validity between objective and subjective data on performance, implying that both are valid when calculating a firm's performance (Homburg et al. 1999; Venkatraman and Ramanujam 1986). We included questions involving both types of assessment in our interviews, but the managers were more open to offering their general views than to offering precise quantitative data. When possible, we calculated the correlation between objective and subjective data, and these were high and significant. We developed a confirmatory factor analysis to validate our scales ($\chi^2_9 = 26.19$, NFI = .98, NNFI = .97, GFI = .99, CFI = .98, IFI = .98) and showed that the scale was one-dimensional and had high validity and reliability ($\alpha = .914$). We used a Likert-type 7-point scale (1 "Much worse than my

competitors," 7 "Much better than my competitors") to ask about the organisation's performance as compared with that of its most direct competitors.

3.2.6 Size

The size indicators used initially were annual turnover and number of employees. Both indicators were highly and significantly correlated in this sample, and we chose to use number of employees as a control variable. The logarithm of the organisation's number of employees was used to measure size.

3.3 Model and analysis

To estimate and contrast the structural equations model (SEM) proposed in this study, we developed different applications or programs, including EQS, AMOS, and LISREL. LISREL is the program used most often, and it is not uncommon to call these structural equations models LISREL models (Jöreskog et al. 2001). The program LISREL 8.80 was used to test the theoretical model in this research. Figure 1 shows the basis of the model proposed, together with the hypotheses to be contrasted. We used a recursive non-saturated model, taking top management support for ICTs (ξ_1) and size (ξ_2) as the exogenous latent variables, knowledge acquisition (η_1) as the first-grade endogenous latent variable, and knowledge transfer (η_2), knowledge utilisation (η_3), and organisational performance (η_4) as the second-grade endogenous latent variables. Through flexible interplay between

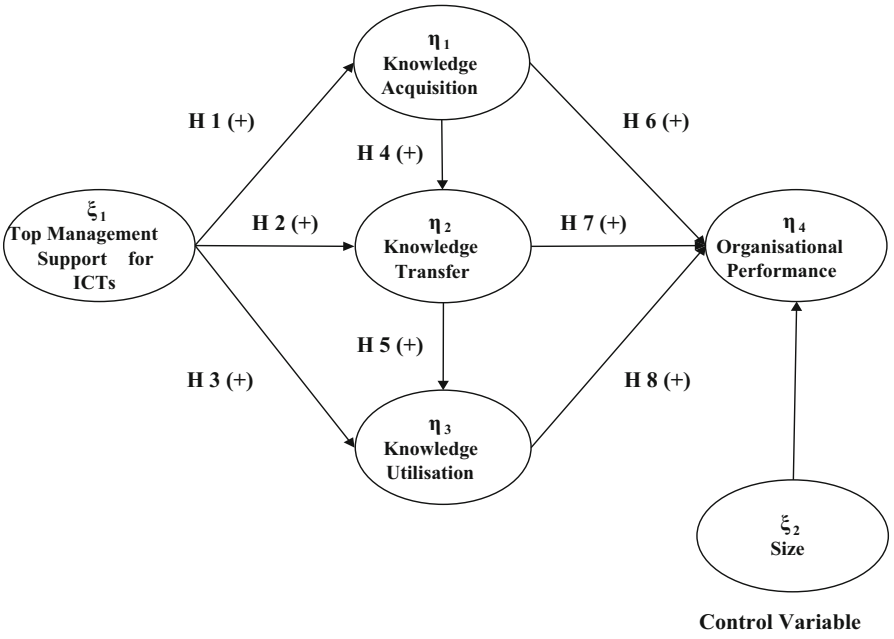

Fig. 1 Hypothesised model

theory and data, this structural equation model approach bridges theoretical and empirical knowledge for a better understanding of the real world. Such analysis allows for modelling based on both latent and manifest variables, a property well suited to the hypothesised model, where most of the represented constructs are abstractions of unobservable phenomena. Further, structural equation modelling takes into account errors in measurement, variables with multiple indicators, and multiple-group comparisons (Koufteros et al. 2009).

4 Results

This section presents the main results of our research. Following the two-step approach advocated by Anderson and Gerbing (1988), we estimated a measurement model before examining the structural model relationships. From Table 2, we can

Table 2 Measurement-model results

Variables	Items	λ*	R^2	C.R.	AVE
Top management support to ICTs	MANSUP1	0.79 (20.29)***	0.63	0.869	0.690
	MANSUP2	0.83 (20.92)***	0.68		
	MANSUP3	0.87 (21.59)***	0.76		
Knowledge acquisition	KACQU3	0.74 (19.84)***	0.55	0.839	0.566
	KACQU4	0.72 (19.38)***	0.52		
	KACQU7	0.78 (20.69)***	0.62		
	KACQU8	0.77 (20.69)***	0.60		
Knowledge transfer	KTRAN1	0.73 (22.58)***	0.54	0.874	0.581
	KTRAN2	0.73 (22.66)***	0.54		
	KTRAN3	0.81 (24.27)***	0.66		
	KTRAN4	0.80 (24.04)***	0.64		
	KTRAN5	0.74 (22.98)***	0.55		
Knowledge utilisation	KUTILIS1	0.72 (22.16)***	0.52	0.903	0.703
	KUTILIS2	0.93 (26.41)***	0.87		
	KUTILIS3	0.88 (25.62)***	0.78		
	KUTILIS4	0.81 (24.35)***	0.66		
Organisational performance	PERFOR1	0.80 (22.97)***	0.63	0.914	0.642
	PERFOR2	0.82 (23.46)***	0.68		
	PERFOR3	0.84 (23.92)***	0.70		
	PERFOR4	0.76 (22.47)***	0.58		
	PERFOR5	0.86 (24.54)***	0.73		
	PERFOR6	0.72 (21.44)***	0.52		
Goodness-of-fit statistics	$\chi^2_{216} = 379.79$ ($p > 0.01$), ECVI = 2.76, AIC = 499.79, CAIC = 757.99, NFI = 0.99, NNFI = 0.99, IFI = 0.99, PGFI = 0.77, PNFI = 0.85, NCP = 163.79, RFI = 0.99, CFI = 0.99, RMSEA = 0.06				

λ* = Standardised structural coefficient (*t* students are shown in parentheses); R^2 = reliability; C.R. = composite reliability; AVE = average variance extracted; *** $p < 0.001$ (two-tailed)

see that all the indices show very good fit with the model [χ^2 (216 d.f.) = 379.79 ($p > 0.01$); NFI = 0.99; NNFI = 0.99; IFI = 0.99; PGFI = 0.77; NCP = 163.79; RFI = 0.99; CFI = 0.99; RMSEA = 0.06]. The constructs display satisfactory levels of reliability, indicated by composite reliabilities ranging from .84 to .91 and average variance extracted coefficients from .56 to .70. Convergent validity can be judged by examining both the significance of the factor loadings and the average extracted variance (>.50). All of the multi-item constructs met this criteria, each loading (λ) being significantly related to its underlying factor (t values >19.38) in support of convergent validity.

The measurements also achieve discriminant validity, the degree to which a construct differs from others, among all constructs. The squared correlation between each pair of constructs is lower than the levels of average variance extracted (Table 3). Further, no confidence interval in the estimation of the correlation between each pair of factors contains the value 1 (Anderson and Gerbin 1988; Fornell and Larcker 1981). Additionally, discriminant validity was established between each pair of latent variables by constraining the estimated correlation parameter between them to 1.0 and then performing a Chi square difference test on the values obtained for the constrained and unconstrained models (Anderson and Gerbin 1988). The resulting significant differences in Chi-square indicate that the constructs are not perfectly correlated and that discriminant validity is achieved.

Table 4 presents the results for the structural model depicted in Fig. 2. Structural equation modelling was performed to estimate direct and indirect effects using LISREL, with the correlation matrix as input. The overall fit of the structural model was good, and the completely standardised path estimates indicate significant relationships among the constructs. If we examine the standardised parameter estimates, the findings show that top management support for ICTs is closely related to and affects knowledge acquisition ($\gamma_{11} = .57$, $p < .001$, $R^2 = .33$), as was predicted in Hypothesis 1 and determined in previous research (Alavi and Tiwana

Table 3 Discriminant validity

Variable	1	2	3	4	5	6
1. Top management support for ICTs	**0.690**	(0.44, 0.59)	(0.47, 0.61)	(0.47, 0.60)	(0.31, 0.42)	(0.01, 0.21)
2. Knowledge acquisition	0.260	**0.566**	(0.42, 0.54)	(0.46, 0.58)	(0.28, 0.39)	(−0.12, 0.07)
3. Knowledge transfer	0.291	0.230	**0.581**	(0.58, 0.70)	(0.34, 0.43)	(0.05, 0.21)
4. Knowledge utilisation	0.280	0.270	0.409	**0.703**	(0.34, 0.43)	(−0.04, 0.13)
5. Organisational performance	0.129	0.115	0.144	0.144	**0.642**	(0.06, 0.21)
6. Size	0.012	0.001	0.016	0.002	0.016	**1.000**

Numbers on the diagonal show the AVE. Numbers below the diagonal represent the squared correlation between the constructs. Numbers above the diagonal represent the confidence interval between each pair of constructs (95 %)

Table 4 Structural model result (direct, indirect, and total effects)

Effect from		To	Direct effects[a]	*t*	Indirect effects[a]	*t*	Total effects[a]	*T*
Top management support for ICTs	→	Knowledge acquisition	0.57***	9.57			0.57***	9.57
Top management support for ICTs	→	Knowledge transfer	0.37***	5.45	0.18***	5.76	0.55***	9.69
Top management support for ICTs	→	Knowledge utilisation	0.33***	5.07	0.26***	7.61	0.59***	10.03
Top management support for ICTs	→	Organisational performance			0.31***	9.88	0.31***	9.88
Knowledge acquisition	→	Knowledge transfer	0.31***	4.98			0.31***	4.98
Knowledge acquisition	→	Knowledge utilisation			0.15***	3.79	0.15***	3.79
Knowledge acquisition	→	Organisational performance	0.17***	4.03	0.08***	4.02	0.25***	6.00
Knowledge transfer	→	Knowledge utilisation	0.48***	7.42			0.48***	7.42
Knowledge transfer	→	Organisational performance	0.16**	2.94	0.10***	3.64	0.26***	6.03
Knowledge utilisation	→	Organisational performance	0.21***	3.93			0.21***	3.93
Size	→	Organisational performance	0.11**	2.62			0.11**	2.62
Goodness of fit statistics		$\chi^2_{221} = 382.33$ ($p > 0.01$), ECVI = 2.46, AIC = 492.33, CAIC = 729.01, NFI = 0.99, NNFI = 0.99, IFI = 0.99, PGFI = 0.79, NCP = 161.33, RFI = 0.99, CFI = 0.99, RMSEA = 0.06						

* $p < .05$; ** $p < .01$; *** $p < .001$ (two-tailed)

[a] Standardised structural coefficients

2002; Pitt and MacVaugh 2008). Top management support for ICTs is also closely related to and affects knowledge transfer ($\gamma_{21} = .37$, $p < .001$). Furthermore, we have shown an indirect effect of top management support for ICTs on knowledge transfer (.18, $p < .001$) through knowledge acquisition (.57 × .31; see, for instance, Bollen 1989 for calculation rules). The global influence of top management support for ICTs on knowledge transfer is thus 0.55 ($p < .001$), as predicted in Hypothesis 2. This result is in line with previous research (Bolisani and Scarso 2000; Roberts 2000). Comparing the magnitudes of these effects indicates that the effect of top management support for ICTs on knowledge transfer is larger than that of knowledge acquisition on knowledge transfer. Globally, knowledge transfer is explained well by the model ($R^2 = .37$).

Knowledge utilisation is influenced by top management support for ICTs ($\gamma_{31} = .33$, $p < .001$). We have also shown an indirect effect of top management support for ICTs on knowledge utilisation (.26, $p < .001$) through knowledge transfer (.37 × .48) and knowledge acquisition–knowledge transfer (.57 × .31 × .48). The

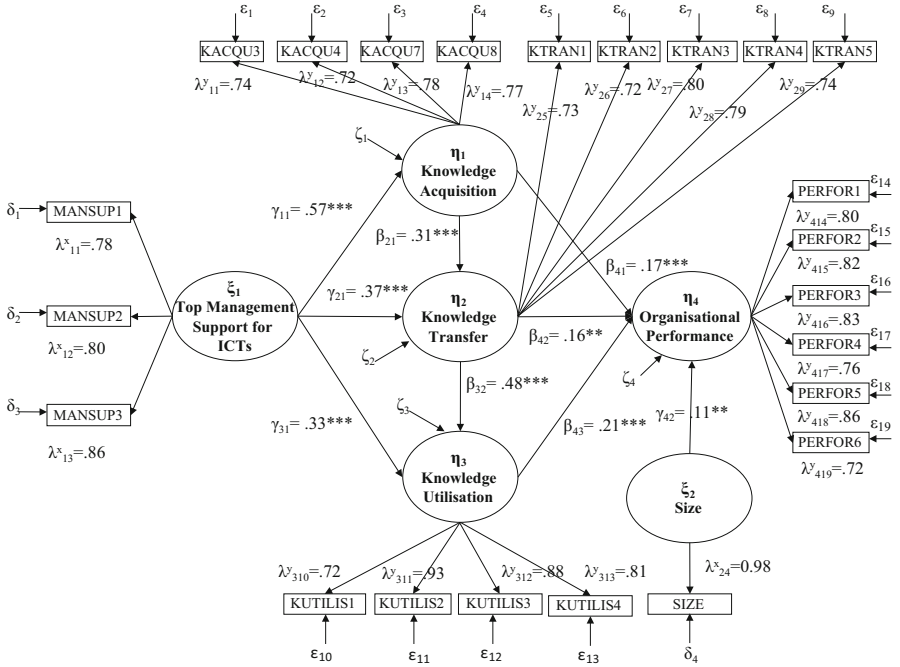

Fig. 2 Results of structural equation model

global influence of top management support for ICTs on knowledge utilisation is thus 0.59 ($p < .001$), as predicted in Hypothesis 3 and previous studies (Storck and Hill 2000). Comparing the magnitudes of these effects indicates that the global effect of top management support for ICTs on knowledge utilisation is larger than the effect of knowledge acquisition or knowledge transfer on knowledge utilisation. Globally, human development practices are explained well by the model ($R^2 = .52$).

Knowledge transfer is influenced by knowledge acquisition ($\beta_{21} = .31$, $p < .001$) and knowledge utilisation by knowledge transfer ($\beta_{32} = .48$, $p < .001$), supporting Hypotheses 4 (Alavi and Leidner 2001; Boland et al. 1994) and 5 (Alavi and Leidner 2001; Szulanski 1996). Further, we have shown an indirect effect of knowledge acquisition on knowledge utilisation (.15, $p < .001$) by knowledge transfer (.31 × .48).

The results indicate that organisational performance is influenced by knowledge acquisition ($\beta_{41} = .17$, $p < .001$), knowledge transfer ($\beta_{42} = .16$, $p < .01$), and knowledge utilisation ($\beta_{43} = .21$, $p < .001$). We have also shown an indirect effect of knowledge acquisition on organisational performance (.08, $p < .001$) by knowledge transfer (.31 × .16) and knowledge transfer–knowledge utilisation (.31 × .48 × .21), as well as an indirect effect of knowledge transfer on organisational performance (.10, $p < .001$) by knowledge utilisation (.48 × .21). The global influence on organisational performance of knowledge acquisition (.25, $p < .001$), knowledge transfer (.26, $p < .001$), and knowledge utilisation (.21,

$p < .001$) supports Hypotheses 6, 7, and 8 and results from other research (Davenport and Prusak 1998; Si and Bruton 2005; Steensma and Lyles 2000). Organisational performance is also influenced indirectly by top management support for ICTs (.31, $p < .001$) through knowledge acquisition (.57 × .17), knowledge acquisition–knowledge transfer (.57 × .31 × .16), knowledge acquisition–knowledge transfer–knowledge utilisation (.57 × .31 × .48 × .21), knowledge transfer (.37 × .16), knowledge transfer–knowledge utilisation (.37 × .48 × .21), and knowledge utilisation (.33 × .21). Comparing the magnitudes of these effects indicates that the total effect of top management support for ICTs on organisational performance is larger than the effect of knowledge acquisition, knowledge transfer, or knowledge utilisation. Globally, organisational performance is explained well by the model ($R^2 = .11$).

In testing the theoretical framework, comparisons with reasonable alternative models are recommended as a means of showing that a hypothesised model is the best representation of the data (Bollen and Long 1993). The summary of the statistics in Table 5 indicates that Model 1 is preferable to the others, supporting the inclusion of a model with these relationships among the constructs analysed. The proposed theoretical model (Fig. 2) represents the most acceptable and parsimonious model. For example, if we compare Model 1 (theoretical model) with Model 5, we can see that the latter has a worse RMSEA ($\Delta = .012$), ECVI ($\Delta = .34$), AIC ($\Delta = 67.79$), and NCP ($\Delta = 68.79$). The results show that Model 1 is preferred to Model 5 ($\Delta\chi^2 = 69.79$) and to the other models.

5 Discussion and conclusions

5.1 Theoretical contributions

Based on the findings of this study, it can be concluded that each of the three processes of knowledge management (knowledge acquisition, transfer, and utilisation) affects positively the relationship between top management support

Table 5 Model statistics against theoretical model

Model	Description	χ^2	$\Delta\chi^2$	RMSEA	ECVI	AIC	NCP
1	Theoretical	382.33		0.060	2.46	492.33	161.33
2	W.R. top management support for ICTs to knowledge transfer	425.44	43.11	0.068	2.67	533.44	203.44
3	W.R. top management support for ICTs to knowledge utilisation	401.12	18.79	0.064	2.55	509.12	179.12
4	W.R. knowledge acquisition to knowledge transfer	400.00	17.67	0.063	2.54	508.00	178.00
5	W.R. knowledge transfer to knowledge utilisation	452.12	69.79	0.072	2.80	560.12	230.12

W.R. without relationship

for ICTs and organisational performance in technology organisations. Therefore, this research first shows the stage-based disaggregation of the knowledge management process into knowledge acquisition, transfer, and utilisation.

First, this research shows the stage-based disaggregation of the knowledge management process into knowledge acquisition, transfer, and utilisation. Various published studies to date stress that knowledge management is a multidimensional construct (Cohen and Levinthal 1990; Garcia Morales et al. 2008; Quintas et al. 1997; Lane and Lubatkin 1998; Todorova and Durisin 2007; Webb 1998; Zahra and George 2002), although there is no consensus among researchers to establish the number of phases that compose the study construct. Our study argues that knowledge management is composed of a dynamic, continuous set of practices and processes that require the participation of all members of the organisation, as well as the creation in the organisation of appropriate social and physical structures to permit the presence of the right interrelation among the different processes of knowledge acquisition, transfer, and utilisation (Darroch 2003, 2005). The organisation's members participate in the different aspects and processes of knowledge management at different moments in time (Alavi and Leidner 2001). Our research shows the existence of these three processes and the interrelation between them. The stages in knowledge management can be thought of as links in a chain. If any link is weak or fails, the effectiveness and integrity of the overall process will suffer (Alavi and Leidner 2001). Thus, attempts at strengthening knowledge management in organisations should consider the synergistic interdependencies among the processes and avoid suboptimisation in relation to any specific process (Alavi and Leidner 2001; Lee and Yang 2000).

Second, this study has shown the mediating mechanism of the three-stage management process in the relationship between top management support for ICTs and organisational performance. The results suggest that, to improve organisational performance, top management should support the ICTs that enhance not only the acquisition of knowledge but also its subsequent transfer and use. The interrelation between these stages of knowledge permits top management support for ICTs to create loops of positive synergy that enable increase in organisational performance (Haque and Anwar 2012). Top management support must promote a knowledge-based culture through provision of funds for knowledge infrastructure and the improvement of employees' capabilities for knowledge acquisition, transfer, and utilisation (Brockman and Morgan 2003). But this support must also focus on the communication and information systems. The firm's technological infrastructure is considered a necessary component of any organisation to implement the communication and information system, since this system makes the technical capability to acquire, transmit, and apply knowledge available to employees (Haque and Anwar 2012). ICTs thus facilitate conversation and connect people with knowledge, acting as a medium for the flow of knowledge (Gold et al. 2001). If an organisation offers support for ICTs by providing employees with adequate ICT systems and endows the organisation with the resources, learning, and training necessary for their use, the organisation's members will improve in applying processes of knowledge acquisition, transfer, and use, while simultaneously achieving significant

improvement in the organisation's overall performance (Davenport and Prusak 1998; Haque and Anwar 2012).

5.2 Managerial implications

The study has various implications for management. First, top management should support the development of the organisation's strategic resources, among them particularly the putting into practice of the knowledge acquired and transferred to obtain competitive advantage (Alavi and Leidner 2001; Knol et al. 2014). Top management should also strengthen the capabilities that the firm's members need to manage each of these knowledge processes, creating an environment, culture, and system of organisational learning. Efficient management of the organisational learning processes and achievement of an organisational culture based on knowledge will encourage greater innovation and technological advantage, which will lead to an increase in business value (Martin Rojas et al. 2011). Prior studies show that new knowledge management systems enable firms to move into profitable niche markets and thus to increase income (Alavi and Leidner 2001).

Adopting a perspective based on resources and capabilities enables organisations to develop and invest in their strategic activities to obtain a competitive advantage relative to other organisations. These investments should drive ICTs and training in them and should involve all of the organisation's human resources, as a process necessary for innovation, development of new products, or delivery of new services (Brockman and Morgan 2003). Promoting ICTs and learning and the abilities necessary for management of them enables the development of a strategic framework that encourages the acquisition, transfer, and use of knowledge in the firm and the possibility of responding in a more flexible way to the current turbulent entrepreneurial environment (Martin Rojas et al. 2011; Skerlavaj and Dimovski 2006). Investment in ICTs, accompanied by greater effort by the entire organisation to achieve higher levels of knowledge, will give rise to better organisational performance (Skerlavaj and Dimovski 2006).

Second, as to the stages of knowledge management and their relation to each other as connected and interrelated processes, firms should promote ICTs and employ them to stimulate the use of accumulated experience, learning processes, and social relationships to promote improvement of the processes of acquisition, transfer, and use of knowledge that act as mediators for obtaining improvements in organisational innovation and performance (Garcia Morales et al. 2008; Martin Rojas et al. 2011). The incorporation of knowledge in transactive memory systems, short-hand languages, routines, technologies, and other knowledge repositories can promote knowledge retention, transfer, and utilisation in firms. But value creation requires firms to go beyond mere use of ICTs and to use ICTs to obtain and employ the strategic knowledge of different interest groups or stakeholders, developing the capability needed to manage and use these knowledge sources proactively (Wu et al. 2013). SMEs currently tend to be among the main beneficiaries of the development of ICTs and computing services due to their limited resources, which constrain their ability to make large technological investments. Further, the increasing popularity of online social networking and its emergent reputation as a valuable knowledge-

sharing tool have further increased affordable options for many organisations, particularly SMEs, to meet their knowledge management needs. Indeed, many of the newly emerging knowledge management products seem to offer cloud and social networking functionality (Sultan 2013). In this way, investment in ICTs, social networks, and cloud computing can provide many such organisations with the opportunity to continue to take advantage of new developments in technological at affordable costs. They can also be an important tool for improving the processes of knowledge acquisition, transfer, and use that act as mediators relative to top management support for ICTs and organisational performance (Garcia Morales et al. 2008; Martin Rojas et al. 2011; Sultan 2013). In addition, managers should foster less formalised and centralised organisational structures that stimulate the transfer and utilisation of knowledge, as these structures encourage the integration of departments, units, and work groups, thereby improving trust and communication among their members (Oyefolahan and Dominic 2010).

5.3 Limitations and future research directions

Although this study is one of the few that examines the influence of the stages of knowledge management on the relationship between top management support for ICTs and organisational performance, it has some limitations that may suggest further possibilities for empirical research. First, survey data based on self-reports may be subject to social desirability bias (Podsakoff and Organ 1986). However, an assurance of anonymity can reduce such bias even when responses are related to sensitive topics (Konrad and Linnehan 1995). Still, the responses are subject to interpretation by the individual managers. The low risk of social desirability bias in this study was indicated by several managers who commented that it made no sense at all for their companies to go beyond regulatory compliance. Second, the absence of objective measures is a limitation. However, the external validation of these variables from the archival data of a subset of respondents increased confidence in the self-reports and reduced the risk of common method variance (Sharma 2000). Further, although Harman's one-factor test and another method test found common method variance not to be a problem, it might still be present (Konrad and Linnehan 1995; Podsakoff and Organ 1986). Although Spector (2006) stresses that it is wrong to assume that using a single method automatically produces systematic bias, future research should collect measures of independent and dependent variables from diverse data sources to reduce the influence of any response bias (Podsakoff et al. 2003). The use of a single respondent may have influenced the precision of some measurements. However, the difficulty involved in obtaining sponsors for research based on multiple views of each firm, the value of the knowledge that firms' CEOs possess, and common practice in organisational research led us to take CEOs as the main respondents. Third, the cross-sectional nature of the research into a series of dynamic concepts allows us to analyse only a specific situation in time of the organisations studied, not their overall conduct through time. Our approach has reduced the magnitude of this problem, since dynamic characteristics and causal affirmations can be made if the relationships are based on theoretical rationales (Hair et al. 2010). For this reason, we began with a theoretical effort that would

allow us to identify and confirm the formal existence of the different cause-effect relationships. Finally, our model analyses the direct and indirect relationships between top management support for ICTs, knowledge acquisition, knowledge transfer, knowledge utilisation, and organisational performance. Further studies should consider other factors, such as organisational learning, information technology department technical quality, or integration of technology and business strategy (Byrd and Davidson 2003; Senge et al. 1994). Future studies should be based on a larger sample, preferably in more than one country. It would also be interesting to study similar characteristics with information provided by lower levels of management and employees in the organisation.

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Appendix: Questionnaire items

Top management support for ICTs

1. Top management cultivates information and communication technology project champions.
2. Top management ensures adequate funding of information and communication technology research and development.
3. Top management restructures work processes to leverage opportunities for information and communication technology in the organisation.

Knowledge acquisition

1. The organisation obtains and takes into account the knowledge about changes in the market place.
2. The organisation obtains and takes into account the knowledge provided by customers.
3. The organisation obtains and takes into account the valuable technical know-how that is useful for managing the firm.
4. The organisation actively observes and adopts best practices in our industry.

Knowledge transfer

Indicate the frequency with which the different kinds of knowledge, abilities, techniques, information, etc. are transferred or exchanged between work groups:

1. Current objectives, responsibilities, or activities of the group or section.
2. Specific requirements of projects or orders, such as prediction of scales, market studies, or customers' needs.
3. Written procedures and practical knowledge needed to initiate them (interpretations, classifications of terms, adaptation to the situation…).
4. Practices that have proven superior in their application.
5. Clear recommendation and guidelines for improving performance of processes.

Knowledge utilisation

1. There are incentives and benefit policies for new ideas or suggestions for utilising existing knowledge.
2. There is a culture that encourages knowledge sharing.
3. The organisation encourages the utilisation and application of available knowledge that has been acquired and shared.
4. The organisation has mechanisms to ensure that the knowledge available that has been acquired and shared is used and applied.

Organisational performance

1. Organisational performance measured by return on assets (economic profitability or ROA).
2. Organisational performance measured by return on equity (financial profitability or ROE).
3. Organisational performance measured by return on sales (percentage of profits over billing volume).
4. Level of return on investments made by the firm.
5. Organisation's market share in its main products/services and markets.
6. Growth of sales in its main products/services and markets.

Size

1. Number of employees.

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