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Influence of social media technologies on organizational performance through knowledge and innovation

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Abstract

Purpose – The purpose of this paper is to show how social media technologies (SMT) make the firm proficient to act on business opportunities and reconfigure business resources by encouraging networks to routinize the firm's knowledge and innovation competencies.

Design/methodology/approach – The paper analyzes data obtained from a sample of 201 technological firms located in Spain. Structural equation modeling with Lisrel is used to test the hypotheses.

Findings – This paper contributes to the literature by reflecting empirically in a structural model how SMT drive technological knowledge competencies to improve organizational performance directly and indirectly by leveraging processes of innovation capability in the firm.

Research limitations/implications – The study has some limitations, among them transversal analysis of different constructs. The number of relationships analyzed is limited, as is the literature focuses on a digital vision from a social media point of view.

Practical implications – Some implications for managers emerge. SMT both enable an emergent participatory culture through ubiquitous digital devices and social networks and balance constant connectivity afforded by digital devices.

Originality/value – Drawing on complexity science, the authors develop a conceptual framework to explain how social media, as emergent IS phenomena, help firms to create business value, leveraging network effects and knowledge flows, and increasing innovative capability.

Keywords Innovation, Knowledge management, Social media, Technology, Organizational performance

Paper type Research paper

1. Introduction

Digital business strategies have been increasing recently due to impressive improvements in information systems, communication, and connectivity technologies. These improvements are fundamentally reshaping traditional business strategy, embracing information systems and technologies as digital resources following the resource-based view of strategy (Barney, 1991; Peteraf, 1993; Wernerfelt, 1995).

Social media, which stress the importance of digital business strategy, are fundamentally changing the way we communicate, collaborate, consume, and create. These media have revolutionized the ways organizations relate to the marketplace and society, creating a new world of possibilities and challenges in all aspects of the enterprise, from marketing and operations to finance and human resource management (Aral *et al.*, 2013).

It is often difficult, however, to clarify what is technologically distinctive about social media technologies (SMT). They share many characteristics of prior collaborative technologies, such as group decision support systems (GDSS) (DeSanctis and Poole, 1994)

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and knowledge management systems (KMS) (Alavi and Leidner, 2001). Social media obtain different characteristics from KMS and GDSS. As a function of tiny initiating events (Holland, 1996) magnified by scale-free causes and networking (Caldarelli, 2007; Dodds *et al.*, 2003), social media produce a much more complex, dynamic ecosystem for growth and innovation (Gnyawali *et al.*, 2010). Social media also foster connectivity among individuals. KMS are methods and cost-efficient software products that support knowledge integration among people, processes, technology, and organizational structure (e.g. brainstorming, document management system, content management, expert systems), whether organizational or technological tools (Centobelli *et al.*, 2017; Fink and Ploder, 2009). GDSS are a family of information systems used to support management teams to structure ill-defined problems and to analyze and make group decisions. They enhance managerial decision-making processes by providing management teams with the technology needed to generate and organize ideas in a collaborative environment, identify priorities, and facilitate conflict resolution (Wang and Reani, 2017). Since social media involve information, knowledge, and networking, GDSS and KMS are tools that social media can use to improve connections and increase knowledge-related competencies.

This study focuses on the technology sector. One of its goals is to highlight how SMT encourage knowledge-based technological competencies (technological knowledge competencies (TKC)). Social media give users, managers, and developers new capabilities to act and interact in ways that were difficult or impossible in earlier online or offline settings (Kane *et al.*, 2014). They also enable collaborative ongoing learning. However, these novel capabilities require researchers to adapt in order to apply social media settings or develop new ones (Kane *et al.*, 2014).

The term social media has been applied to varied technologies – wikis, blogs, microblogs, social networking sites, virtual worlds, and video-sharing sites, to name a few (Kaplan and Haenlein, 2010). Social media encompass a wide variety of information and communication technologies (ICT), but their common denominator is connecting users in ways that bridge distance, time, and other traditional barriers. They "represent one of the most transformative impacts of information technology on business, both within and outside firm boundaries" (Aral *et al.*, 2013, p. 3). Through social media and social networking, digital technologies are changing the structure of social relationships in both the consumer and the space of the enterprise (Susarla *et al.*, 2012).

This study attempts to fill gaps in the social media literature: First, Do social media play a key role in firms, improving their business activities to gain business value? Second, How do social networks produce innovative breakthrough in companies? How do they ensure collaborative learning processes through competencies, resources, and strategies to achieve connectivity, dynamicity, and brilliant negotiations, enabling firms to develop and change social interactions in organization or communication technologies? Third, Social media's cooperative competencies often explain differences in competitive advantage and performance between firms. It is widely argued (Lengnick-Hall, 1992; Teece, 1986; Tyler, 2001) that the relationship between technology-based innovations and competitive advantage is shaped by organizational competencies that enable firms to exploit the results of their technological assets. How do organizational competencies encourage organizational performance through social media?

This study aims to answer these questions by analyzing: how social media are a driving force of information systems in contemporary society; and, at global level, how social media enable firm proficiency to act on business opportunities and reconfigure business resources; how TKC foster a dynamic focus on transferring and applying knowledge throughout the company through a continuous learning process; how innovation capability, directly and indirectly through TKC, enables firms to acquire, assimilate, and exploit external knowledge so the organization can produce new innovations perpetually.

To answer these questions and advance existing knowledge, we deepen understanding of: the concept of each variable analyzed, and the relationships between these variables and the causal model that theorizes the influence of all study variables on organizational performance. Our methodology analyzes a sample of high-technology firms to obtain empirical results, which support our hypotheses.

We define TKC as a learning process that generates a flow of new technological knowledge or technological distinctive competencies (Nieto, 2004). Companies innovate in a continuous learning process through which they generate new technological knowledge (Nonaka and Takeuchi, 1995). Converting an activity into a routine is the main way the organization stores its specific operational knowledge (Inkinen *et al.*, 2015; Nelson and Winter, 1982). Here, TKC represent the organization's expertise in mobilizing scientific and technological resources through a series of routines and procedures that enable development and design of new products and/or production processes (Delgado-Verde *et al.*, 2011; Real *et al.*, 2006) to adapt quickly to new opportunities (Prahalad and Hamel, 1990).

Focusing on the seminal concept of innovation from Zaltman *et al.* (1973), Lawson and Samson (2001, p. 384) define innovation capability "as the ability to continuously transform knowledge and ideas into new products, processes and systems for the benefit of the firm and its stakeholders." For Saunila and Ukko (2012), innovation capability is an intangible property the organization can exploit to produce new innovations perpetually.

Studies argue that the relationship between technology-based innovations and competitive advantage is often shaped by organizational competencies that enable firms to exploit the results of their technological resources (Lengnick-Hall, 1992; Teece, 1986). Enterprises should thus strengthen their market orientation and innovation orientation (Zaltman *et al.*, 1973; Rogers, 1983), develop service TKC vigorously, build an organizational learning structure to promote knowledge interaction and collaboration within the organization, improve efficiency of resource utilization, pay more attention to human resource development (Guo *et al.*, 2015), and increase innovation capability in the firm (Damanpour, 1991; Jaakson *et al.*, 2011).

To develop these relationships and achieve the research objectives, we structure this study as follows. Section 2 develops the hypotheses. Section 3 presents the data analysis and methodology. Section 4 explains the measures and structural model, and Section 5 discusses the results. Finally, Section 6 presents the conclusions, theoretical and practical implications, limitations, and lines for future research.

2. Theoretical framework and research hypotheses

2.1 SMT as ICT related to TKC

Managing social media enables firms to obtain information and acquire TKC. Employees and managers learn faster and better than they would without communicating through social media (Ellison *et al.*, 2015). Once they learn to use social media, they encourage TKC and thus effective quality communication. Developing TKC usually produces a virtual learning community that increases firm performance (Villa and Poblete, 2007).

It is easy to demonstrate the active role of social media in the learning process in educational environments, since social media enable collaborative learning among students through efficient information sharing (Segura-Azuara *et al.*, 2016). The better students control these social connections, the stronger the technological knowledge capabilities they develop. For example, Salem *et al.* (2017) show that applying social media technology tools (e.g. Twitter, Flickr, blogging in medical courses, platforms like YouTube) improved students' technological knowledge capacities by increasing students' knowledge and capacity to work with new knowledge provided by new technologies.

The technology sector requires more specific knowledge. Workers (employees or managers) must be highly trained and develop competencies faster and more efficiently through social media, especially to achieve a leading market position (Jussila *et al.*, 2014; Leonardi *et al.*, 2013; Nguyen *et al.*, 2015). TKC can be developed by increasing connections between multiple partners, such as suppliers, distributors, manufacturers, and logistics providers. Increased connection improves a firm's ability to pursue innovative opportunities and gain competitive advantages. For instance, Gnyawali *et al.* (2010) find that MySpace formed alliances with various cell phone companies, TV broadcasters, movietickets.com, and Warner Music to run advertising promotions to attract user traffic to their site. These alliances make it easier for users to access information and to use the MySpace site. MySpace thus increased connections and exploited its TKC to achieve greater site use. Greater use of SMT in these sectors strengthens firms' TKC.

A high level of curiosity and openness to innovation is an important factor for successful application of new media tools (Salem *et al.*, 2017). Small and medium-sized enterprises (SMEs) tended to resist the idea of innovation "for its own sake," viewing innovation as a "risk" requiring great knowledge (Leonardi *et al.*, 2013; Woolgar *et al.*, 1998). However, firms must research the market to compete in a hostile environment. Traditionally, knowing the market meant few technological breakthroughs, as firms tended to rely on "networking" (Torkkeli *et al.*, 2016; Woolgar *et al.*, 1998), but SMEs and firms now tend to be highly heterogeneous and must identify and acquire new technology to allow them to specialize to meet the needs of different stakeholders. With new media tools, they enter the field of complexity, increasing their knowledge (Ellison *et al.*, 2015) and technological competencies (Combs and Meskó, 2015; Hodgson, 2012) based on new technological knowledge.

Since social media enhance emerging technologies and the technological capacity of successful professionals who share their knowledge, firms assume that social media will strengthen their technological competencies, benefitting competitiveness and growth. By exploiting social media, firms develop not only competencies in communication but also willingness to incorporate new technologies to meet the quality standards required (Combs and Meskó, 2015). Such capabilities increase their technological knowledge capabilities through educational programs (Combs and Meskó, 2015; Ellison *et al.*, 2015) and subsequently their market share or performance (Garrido-Moreno *et al.*, 2015).

In the transportation sector, Hodgson (2012) finds that SMT potential lead to strategic collaboration to improve connectivity between firms and customers. New forms of sociality involve mobile electronic and internet connectivity. They produce new patterns of technological knowledge such as GPS use, which provides immediate knowledge of firms' location, people, or transport; and wayfaring, to build maps to collaborate and share information through map sharing (Hodgson, 2012).

Similarly, Kane *et al.* (2014) find that, once SMT enable development of specific capabilities, social media give users technological capability to visualize and analyze network structure accurately. As this skill is associated with performance variation (Krackhardt, 1990), SMT increase connectivity and people's technological capability to use these connections.

In summary, social media produce higher learning engagement, stimulate interaction, and improve feedback. App usage makes specific personalized information permanently available for workers, facilitating knowledge collection (Salem *et al.*, 2017). Since social media increase TKC, we hypothesize that:

H1. SMT have a positive effect on TKC.

2.2 TKC as antecedent of organizational performance

Previous research finds that the firm's R&D activities play a key role in creating their technological competencies (Cohen and Levinthal, 1990); R&D enhances knowledge acquisition and assimilation in the firm. Firms strive to develop TKC through acquisition and implementation of new ideas by learning from partners and screening technology and market developments (Danneels, 2007, 2008; Hamel, 1991). Successful integration of TKC enables companies to outperform competitors because such interaction increases firm efficiency (Lokshin *et al.*, 2009; Melville *et al.*, 2004). For Real *et al.* (2006), technological competencies make crucial contributions to attaining sustainable competitive advantage and superior results.

Once firms develop TKC, they can translate technological knowledge into terms meaningful to managers (Lokshin *et al.*, 2009). TKC in the organization correlates positively with performance (Santhanam and Hartono, 2003; Sharma, 1995; Torkkeli *et al.*, 2016). In high-tech markets, TKC are the single most significant determinants of superior financial performance (Walsh and Linton, 2002).

According to some studies in information systems (Dos Santos *et al.*, 1993; Melville *et al.*, 2004), the association of enterprise resource planning systems with higher financial market value (Hitt *et al.*, 2002) causes technological competencies to influence performance through IT businesses whose value derives from application of innovative IT (Dos Santos *et al.*, 1993) and transaction processing systems (Weill, 1992).

In focusing on social media, TKC should be collaborative and provide information-sharing facilities. They must operate ubiquitously in networked computing environments and supply necessary data and information for workgroups to solve problems and develop more efficient decision-making processes (Prahalad and Hamel, 1990; Scott, 1991; Sharma, 1995). Through such sharing, TKC is very likely to encourage organizational performance (Melville *et al.*, 2004; Santhanam and Hartono, 2003; Torkkeli *et al.*, 2016). Tsai *et al.* (2011) find that TKC enable tacit knowledge transfer and access to the latest technologies, creating synergy-inherent development in firms.

The service sector also achieves these results. Thanks to social media, TKC can foster interaction and collaboration on service enhancement in manufacturing firms, bringing superior responsiveness to operation processes and producing financial savings and improvements in product quality and reliability (Guo *et al.*, 2015). It is essential for service management practitioners to monitor TKC and understand their impact on development and dissemination of technological knowledge throughout the company.

TKC are strategically remarkable for strategic thinking in firms. Competitive advantages derive from using TKC to generate differential satisfaction in profitable markets (Moon, 2013). Song and Parry (1997) find that TKC – among other competencies such as marketing capabilities and resources capabilities – are sources of competitive advantage for successful new product development. They obtain a positive impact of TKC on proficiency in idea development and screening, business and market opportunities analysis, and new product development – activities linked to better positional market advantage. Furthermore, firms may engage in new ventures to acquire TKC to keep strategic options available (Tsai *et al.*, 1991).

Consequently, TKC are crucial for successful firm performance; they form an important backbone, share information without constraints of space and time, shorten time to market for novel products and processes, disseminate new technology (micro-electro-mechanical systems) and knowledge, and operate in markets with short product life cycles and high new product introduction rates (Guo *et al.*, 2015; Kassicieh *et al.*, 2002; Sharma, 1995; Tsai *et al.*, 1991). Essentially, TKC have positive effects on how organizations seek and exploit new opportunities quickly to be more competitive (Martín-Rojas *et al.*, 2011, 2013; Prahalad and Hamel, 1990). Based on this literature, we argue that:

H2. TKC have a positive effect on organizational performance.

2.3 TKC as antecedent of innovation capability

Kogut and Zander (1992, p. 384) argue that a firm's innovative capabilities "rest in the organizing principles by which relationships among individuals, within and between groups, and among organizations are structured." For these authors, innovations are the product of a firm's capability to generate new applications from existing knowledge by building on the firm's social relationships. In an environment with social media, TKC enable the firm's innovation capability.

Recognizing TKC as cooperative competencies, Tyler (2001) uses resource-based theory to suggest that they can compensate for average or potentially below-average technological know-how when firms seek to innovate technologically. To develop innovation capacity, organizations must make successful innovation-to-organization connections by providing collaborative structures and processes to solve problems creatively and link innovations to existing businesses (Henderson and Cockburn, 1994). Enabling firms to integrate technological knowledge within and across their boundaries, TKC constitute an important determinant of heterogeneous competence that encourages innovation capability (Henderson and Cockburn, 1994).

Firms with established TKC in information processing through social media communication have an advantage over other firms (Silvestre and Dalcol, 2009). Technological systems are defined in terms of knowledge flows and capabilities rather than flows of ordinary goods and services (Carlsson, 1995). Technological innovation systems thus combine dynamic knowledge and technological capabilities networks that create TKCs (Carlsson and Stankiewicz, 1991; Tidd and Bessant, 2009). Technological innovation systems increase firms' innovation capability by opening innovative ways to speed up problem-solving processes (Hurley and Hult, 1998). Key elements include technological infrastructure or TKC (Carlsson, 1995).

The most valuable TKC are often highly tacit, residing in communities of individuals (Brown and Duguid, 1991; Mudambi and Swift, 2011). To access this knowledge, firms must join such communities composed of individuals linked in networks (Scott, 1991). The dense communication and rapid mutual comprehension in social media, for example, are key to exchanging and integrating knowledge and fostering innovation (Mudambi and Swift, 2011; Tallman and Chacar, 2011; Torkkeli *et al.*, 2016). In high-tech firms, where social media use is increasingly essential to valuable perspectives and high performance, better-developed TKC produce more developed innovation capability (Belso-Martínez, *et al.*, 2016; Majchrzak and Malhotra, 2016).

In highly competitive industries (high-tech), where technological knowledge is crucial, technological competencies – including capability to explore or exploit technological opportunities, core technology capability, and autonomous R&D decisions – are especially important to firm innovation capability (Huang, 2011). TKC are important for innovation capability in these industries.

In today's environmental dynamicity and uncertainty, firms with higher levels of information processing, communication, and knowledge transfer are more likely to develop TKC and thus successful technological innovation than same-sector firms with lower levels of cooperative resources (Henderson and Cockburn, 1994). Moreover, technological innovation capability requires different sets of TKC (Lengnick-Hall, 1992), an important source of competitive advantage in technologically competitive markets.

Higher levels of TKC competencies are characteristic of firms with higher innovation output. Such firms are very likely to implement strategic thinking and radical new innovations, which require creative and divergent thinking with higher levels of firm competencies (Lokshin *et al.*, 2009; Moon, 2013). Furthermore, firms with TKC absorb complex knowledge and tend to exchange innovation-related knowledge with other cluster units, increasing their innovation capability or innovativeness.

Damanpour (1991) calls these competencies technological knowledge resources because they require utilizing know-how in conjunction with other capabilities (Teece, 1986, p. 288). Based on above-industry-average technological know-how (Burgelman *et al.*, 1996), TKC produce technological innovations capabilities. We thus formulate the following hypothesis:

H3. TKC have a positive effect on innovation capability.

2.4 Innovation capability as antecedent of organizational performance

The relationship between technology-based innovations and competitive advantage is often shaped by organizational competencies that enable firms to exploit the results of their technological assets (e.g. Lengnick-Hall, 1992; Teece, 1986; Tyler, 2001). An immediate source of competitive advantage (Goldman *et al.*, 1995), organizational innovation, can improve performance (Camisón and Villar-López, 2014; Narver and Slater, 1990). Organizational innovation comes from firms' innovation capabilities, which can generate superior incomes (Grant, 1996). It is especially relevant in technology organizations, where greater organizational innovation facilitates achievement of the organizational capabilities needed to respond better to competitive challenges, increasing organizational performance for sustainable competitive advantage (Antoncic and Prodan, 2008; Kollman and Stöckmann, 2014; Leonard-Barton and Deschamps, 1988; Zaltman *et al.*, 1973).

Moreover, innovation capability is an integral dimension of organizational strategy (Gopalakrishnan and Damanpour, 1997; Kimberly and Evanisko, 1981; Rogers, 1983; Wang and Ahmed, 2007; Wilson *et al.*, 1999; Wolfe, 1994; Zaltman *et al.*, 1973). Since high levels of technological innovativeness can lead to high organizational effectiveness and efficiency, improving coordination and co-operation in the organization (Antoncic and Prodan, 2008; Subramanian and Nilakanta, 1996), high levels of innovation capability are representative of aggressive creative strategies (Hurley and Hult, 1998; Miles and Snow, 1978) that make organizations more competitive in the market. The role of social media within and outside the company is especially relevant in such organizations. Developing innovation capability appears to be more effective in the organization as a whole because innovation capability enables creation of new products built using new technologies and thus continuous improvement of products using the latest dominant technology (Christensen, 1997, 2003; Lyytinen and Rose, 2003). Such systems thinking builds in virtuous loops, producing higher innovation, encouraging high business performance (Woodside, 2005), and enabling firms to overcome competitors (Porter and Van der Linde, 1995; Song *et al.*, 2009).

Studying patient networks in hospitals and applying them to similar ventures, Kallinikos and Tempini (2014) show that ICT-facilitated innovation capability enables greater organizational and institutional reach and performance, powering heterogeneous knowledge production initiatives by groups such as patient advocacy organizations.

In higher-level multimedia, technologies and connections between companies and institutions enhance firm innovativeness through accumulation and transfer of technological, commercial, and cultural information among all companies and institutions involved in the activities (Wang and Ahmed, 2004). These connections create new opportunities for growth and dissemination of the firm's network by exploiting know-how to gain competitive advantage (Albino *et al.*, 1998).

Similarly, Cho and Pucik (2005) find that innovation capability and quality affect an organization's performance. For Hurt *et al.* (1977), innovation capability as a tool for proactiveness and exploitation of new opportunities drives growth and increases profit and market value through quality. Consequently, executives should strengthen their firm's cooperative capabilities to promote original technological innovation, thereby promoting innovation capability and organizational performance (Tyler, 2001). Analyzing 26 telecommunication operating companies in four African countries, Marcelle (2005) finds that technological learning processes encouraged innovation capabilities, accumulation of which fosters competitiveness, innovation, and economic development.

Saunila and Ukko (2012) observe the impact of innovation capability on organizational performance by measuring innovation capability and organizational performance. Finally, Neely *et al.* (2001) conceive an organization's innovation capability as the potential to generate innovative outputs. Calantone *et al.* (2002) study innovation capability as the most important determinant of organizational performance. Based on the research cited, we formulate the following hypothesis:

H4. Innovation capability has a positive effect on organizational performance.

3. Research methodology

3.1 Sample description

Several academics, consultants, and general managers with knowledge of the study variables were interviewed to analyze the content and comprehensibility of the measurement scales and questionnaire. The new version was then pretested and revised based on feedback from a random sample of 15 general managers from the database. We analyze the technological sector because technology is increasingly viewed as the basis of any corporate area and vertical or business unit. As one of Spain's most rapidly evolving sectors, the technology sector generates the most new professions to respond to companies' needs, acting as a strategic element for knowledge transfer from academics to the production sector (Martín-Rojas *et al.*, 2013). Spain's economy is one of the largest in Europe. Selecting a geographic, legal, political, and cultural space enables us to reduce the impact of variables that cannot be empirically controlled (Fernández-Pérez *et al.*, 2014). The sample was selected from the SABI and Amadeus databases.

We used CEOs as key informants. Key decision makers with knowledge of how the system as a whole operates and of the variables analyzed, CEOs have been employed in similar research (Baer and Frese, 2003). Different studies show data from CEOs to be as reliable and valid as data from multiple informants (Zahra and Covin, 1993). The list of CEOs was drawn from the Local Council for Economy, Innovation, and Science of Andalusia's Regional Government and the Spanish Ministry of Science and Research by selecting randomly 850 Spanish firms (Table I). Calls and e-mails during January and March 2017 sought to increase participation. A total of 201 valid questionnaires were obtained (23.64 percent response rate). We promised confidentiality and aggregate treatment of information from the results to reduce possible desirability bias. Comparing annual sales and number of employees from non-responding and responding firms, and from early and late respondents showed no statistically significant differences (Armstrong and Overton, 1977).

3.2 Research instrument

The investigation used multi-item seven-point Likert scales adapted from measures validated in previous studies. Table II lists the specific items utilized in this study.

SMT: this construct analyzed the frequency with which different social media (e.g. Facebook, Twitter, YouTube, LinkedIn, Blogs, Wikis, or Discussion Forums) were used (1 "Not very often" to 7 "Very often") based on previous scales (Choudhury and Harrigan, 2014; Sigala, 2011). Confirmatory factor analysis (CFA) ($\chi^2_{27} = 67.61$, normed fit index (NFI) = 0.99, non-normed fit index (NNFI) = 0.99, comparative fit index (CFI) = 0.99,

Table I. Technical details of the research

Sector	Technological sector
Geographical location	Spain
Methodology	Structured questionnaire
Universe of population	2,023 firms
Sample size (response size)	850 firms (201 firms, 23.64%)
Sample error	6.9%
Confidence level	95%, $p-q=0.50$; $Z=1.96$
Period of data collection	From January to March 2017

Social media technologies (SMT)	Frequency of use/extent of use of social media technologies Facebook (www.facebook.com) (SMTEC1) Twitter (www.twitter.com) (SMTEC2) YouTube (www.youtube.com) (SMTEC3) LinkedIn (www.linkedin.com) (SMTEC4) Blogs (SMTEC5) Wikis (SMTEC6) Discussion forums (SMTEC7)
Technological knowledge competencies (TKC)	Indicate the extent to which firm developed over the past three years and has the following technological capabilities listed Capability to obtain information about the status and the progress of relevant technologies (K1) Capability to generate advance technological processes (K2) Capability to assimilate new technologies and useful innovations or those with a proved potential (K3) Capability to attract and retain its qualified scientific-technical staff with knowledge (K4) Capability to dominate, generate, or absorb basic and key knowledge (K5) Effectiveness in setting-up programs oriented to internal development of technological or technology absorption competencies (K6)
Innovation capability (IC)	Indicate the extent of changes that have taken place in the company over the past three years The company's spending on new product/process development activities (INNO1) The number of new products/processes added and introduced by your company (INNO2) The company's emphasis on developing technologies and/or technological innovation (INNO3) Top management emphasis on R&D, technological leadership, and innovations (INNO4)
Organizational performance (OP)	Relative to your main competitors, what is your firm's performance in the last three years in the following areas? Return on investment (ROI) (Perfor1) Return on equity (ROE) (Perfor2) Return on sales (ROS) (Perfor3) Recovery of investments (Perfor4) Market share growth (Perfor5) Growth of sales in its main products and/or services (Perfor6)
Size	Number of employees
Sector	CNAE

Table II.
Measurements

goodness of fit index (GFI) = 0.99) was used to validate the scale and verify its one-dimensionality, demonstrating high validity and reliability.

TKC: drawing on a previous scale (Real *et al.*, 2006), we designed a seven-item scale (1 "Totally disagree" to 7 "Totally agree"). CFA was used to validate the scale ($\chi^2_9 = 15.11$, NFI = 0.99, NNFI = 0.99, CFI = 0.98, GFI = 0.99) and demonstrated its one-dimensionality, validity, and reliability.

Innovation capability: a seven-item Likert scale was constructed (1 "Totally disagree" to 7 "Totally agree"), adapting items from Knight (1997) and Zahra (1993) to this study. CFA validated the scales ($\chi^2_2 = 7.18$, NFI = 0.99, NNFI = 0.99, CFI = 0.99, GFI = 0.99), showing one-dimensionality and high validity and reliability.

Organizational performance: a Likert-type seven-point scale (1 "Much worse than my competitors" to 7 "Much better than my competitors") with six items developed by Murray and Kotabe (1999) was used to measure organizational performance compared to most direct competitors. Recent studies evaluate performance compared to main competitors

(García-Morales *et al.*, 2014) and use subjective data on performance when they correlate with objective data, as is the case in this study (Martín-Rojas *et al.*, 2011, 2013). CFA validated the scales ($\chi^2_9 = 18.44$, NFI = 0.99, NNFI = 0.99, GFI = 0.99, CFI = 0.99), demonstrating their one-dimensionality and high reliability.

Size: enterprises were classified by number of persons employed: large enterprises (250 or more employees) and SMEs (< 250 employees).

Sector: sector was analyzed based on the manufacturing sector's technology level.

3.3 Statistical methods

Structural equation modeling (SEM) was used to analyze the structural relationships proposed. This technique estimates multiple and interrelated dependence in a single analysis, enabling decomposition into direct and indirect effects to test the model's goodness of fit. Lisrel 8.8 (linear structural relations) was used to analyze the relation between the variables measured and the latent constructs, or between endogenous and exogenous variables.

Our analysis follows Anderson and Gerbing (1988), who indicate the need to apply a two-step approach, first estimating a measurement model that illustrates how the variables measured come together to represent the theory and, second, designing a structural model that shows how the constructs relate to other constructs.

4. Data analysis

4.1 Measurement model evaluation

The measurement model shows very good fit (χ^2 (224 df) = 374.86 ($p > 0.01$); NFI = 0.98; NNFI = 0.99; incremental fit index (IFI) = 0.99; parsimony goodness of fit index (PGFI) = 0.58; estimated non-centrality parameter (NCP) = 150.86; relative fit index (RFI) = 0.98; CFI = 0.99; root mean square error of approximation (RMSEA) = 0.05). The diagnostic stage of the goodness of fit refers to the precision with which the assumptions of the model specified determine whether the model is correct and serves to approximate the real phenomenon, thus specifying the model's predictive power. There are three types of measurement of fit quality: first, absolute fit measures, which evaluate the model's overall fit (e.g. χ^2, NCP, RMSEA, ECVI), second, incremental fit measures, which compare the proposed model to other models specified by the researcher (e.g. NFI, NNFI, IFI, RFI, CFI), and third, parsimony fit measures, which adjust the fit measures to compare models with different numbers of estimated coefficients in order to determine the quantity of fit achieved by each coefficient estimated (e.g. PGFI, AIC). The values obtained show good fit of the model (Hair *et al.*, 2009). Table III shows Cronbach's α, composite reliability, average variance extracted (AVE), factor loading and t-values of the different measurements. Cronbach's αs take values from 0.92 to 0.97, above the recommended 0.707 minimum (Nunnally and Bernstein, 1994). Composite reliabilities range from 0.93 to 0.98 and the AVE from 0.69 to 0.89, above the recommended minimums, 0.70 and 0.50, respectively (Fornell and Larcker, 1981; Hair *et al.*, 2009). The latent construct accounts for at least 50 percent of item variance. Furthermore, each loading (λ) is significantly related to its underlying factor (t-values > 1.96). The significance of the factors loadings is appropriate and the measurements reliable, supporting convergent validity of the measures.

As to discriminant validity of the measurement (following Fornell and Larcker, 1981), the AVE for each construct (values on the diagonal in Table IV) was greater than its squared correlations with any other construct. All constructs show sufficient discriminant validity. Furthermore, when estimating the correlation between each pair of factors, the value 1 was not present in any confidence interval, also indicating that the constructs differ from each other and supporting discriminant validity.

Variables	Items	λ* (*t*-value)	R^2	α	CR	AVE
Social media technologies (SMT)	SMTEC1	0.74*** (14.80)	0.54	0.923	0.939	0.690
	SMTEC2	0.81*** (20.53)	0.65			
	SMTEC3	0.84*** (28.08)	0.71			
	SMTEC4	0.85*** (23.23)	0.71			
	SMTEC5	0.94*** (52.23)	0.88			
	SMTEC6	0.76*** (16.52)	0.59			
	SMTEC7	0.86*** (27.09)	0.74			
Technological knowledge competencies (TKC)	K1	0.92*** (45.24)	0.84	0.976	0.981	0.899
	K2	0.95*** (69.48)	0.89			
	K3	0.96*** (104.85)	0.93			
	K4	0.95*** (56.47)	0.89			
	K5	0.95*** (68.58)	0.90			
	K6	0.96*** (98.88)	0.92			
Innovation capability (IC)	INNO1	0.92*** (53.52)	0.86	0.952	0.961	0.860
	INNO2	0.93*** (67.42)	0.86			
	INNO3	0.95*** (63.79)	0.90			
	INNO4	0.91*** (46.82)	0.83			
Organizational performance (OP)	PERFOR1	0.95*** (69.25)	0.91	0.974	0.974	0.863
	PERFOR2	0.97*** (120.25)	0.95			
	PERFOR3	0.95*** (79.75)	0.91			
	PERFOR4	0.95*** (61.96)	0.90			
	PERFOR5	0.87*** (14.39)	0.76			
	PERFOR6	0.88*** (14.59)	0.78			

Notes: λ*, standardized structural coefficient (Student's *t*s are shown in parentheses); R^2, reliability; CR, composite reliability; AVE, average variance extracted. ***$p < 0.001$ (two-tailed)

Table III. Measurement model results

Variables	SMT	TKC	IC	OP
SMT	*0.690*	(0.49, 0.70)	(0.26, 0.53)	(0.51, 0.70)
TKC	0.322	*0.899*	(0.64, 0.80)	(0.52, 0.72)
IC	0.150	0.494	*0.860*	(0.64, 0.80)
OP	0.329	0.350	0.477	*0.863*

Notes: 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 percent). Size and Sector are not included in this table

Table IV. Discriminant validity

Since the research was based on a single respondent and self-reported data, various methods were used to assess whether common method bias threatened reliability of the results. First, following recommendations by Podsakoff *et al.* (2003) and Pandey *et al.* (2008) to reduce common-source design bias, the research enhanced survey anonymity and clarity of the study goals, used scales previously tested and validated, randomized item order in surveys of subjects and items asking about organizational actions rather than individual cognitions, and chose key informants with knowledge of the constructs analyzed. Second, Harman's one-factor test and exploratory factor analysis were performed. The one-factor model obtained using principal components produced several factors with eigenvalues greater than 1.0 and accounted for 79 percent of the total variance. The presence of several factors and the fact that the first factor did not account for the majority of the variance suggests the absence of significant method variance (Konrad and Linnehan, 1995; Podsakoff and Organ, 1986). Third, CFA to test common method bias showed that the fit was worse for the one-dimensional model than for the measurement model (RMSEA ($\Delta = 0.218$), NFI ($\nabla = 0.18$), CFI ($\nabla = 0.18$), expected cross-validation index (ECVI) ($\Delta = 15.69$), Akaike information criterion (AIC) ($\Delta = 3136.49$). Thus, common method variance did not pose a serious problem. Finally, a first-order factor was added, and all measures as indicators of the theoretical research model and the indicator loadings before and after adding the common latent factor were compared. The differences were smaller than 0.200, indicating that common method bias was not a significant threat (Podsakoff *et al.*, 2003). Collectively, these tests show that the constructs do not suffer from common method bias.

4.2 Structural model evaluation

A structural model was proposed (Figure 1) based on the two-step approach (Anderson and Gerbing, 1988) and the theory. We used a recursive non-saturated model, taking SMT (ξ_1) as exogenous latent variable, TKC (η_1) as first-grade endogenous latent variable, and innovation capability (η_2) and organizational performance (η_3) as second-grade endogenous latent variables. SEM incorporates errors in measurement, multiple-group comparisons, and variables with multiple indicators.

Table V summarizes the descriptive statistics and correlations among the variables employed to analyze the model. The data analysis used the covariance and asymptotic covariance matrix. The goodness of fit of the global model and total effects (including estimated direct and indirect effects) were analyzed through the structural paths proposed.

All estimated standardized paths indicate significant relationships among the constructs (Figure 2) with good overall fit of the structural model ($\chi^2(226\ \text{df}) = 392.14$ ($p > 0.01$); NFI = 0.98; NNFI = 0.99; IFI = 0.99; PGFI = 0.58; NCP = 166.14; RFI = 0.99; CFI = 0.99; RMSEA = 0.06). All relationships of the model tested were statistically significant, supporting all study hypotheses. Table VI presents the results of the structural model.

5. Discussion of the results

The null hypothesis confirms that there is no association between the two study variables. The alternative hypothesis confirms a relationship or association between the two variables. We reject the null hypothesis if the p-value associated with the result observed is

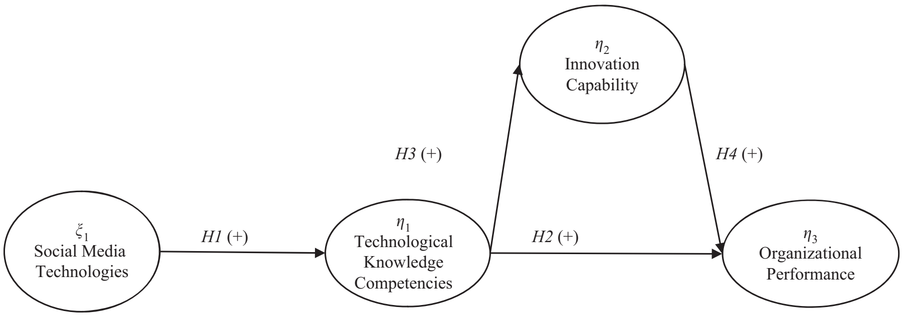
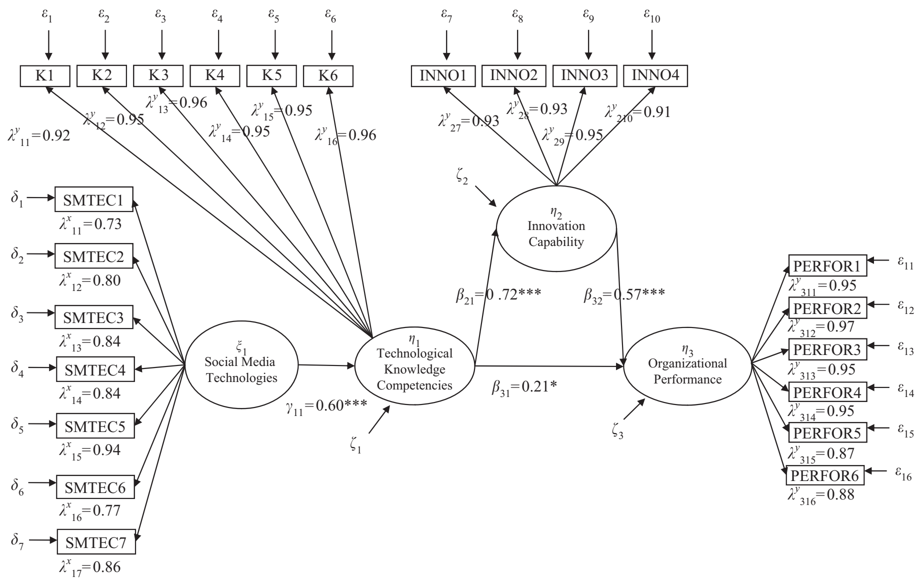


Figure 1. Proposed research model

Table V. Means, standard deviations, and correlations

Variable	Mean	SD	1	2	3	4
1. Social media technologies	3.031	1.527	1.000			
2. Technological knowledge competencies	3.694	1.524	0.568***	1.000		
3. Innovation capability	4.158	1.606	0.388***	0.703***	1.000	
4. Organizational performance	4.376	1.459	0.574***	0.592***	0.691***	1.000

Notes: $n = 201$. $*p < 0.05$; $**p < 0.01$; $***p < 0.001$



Notes: *$p<0.05$; **$p<0.01$; ***$p<0.001$

Figure 2. Structural model

Effect from		To	Direct effects	t	Indirect effects	t	Total effects	t
Social media technologies	→	Technological know. comp.	0.60***	9.48			0.60***	9.48
Social media technologies	→	Innovation capability			0.43***	8.04	0.43***	8.04
Social media technologies	→	Organizational performance			0.37***	6.57	0.37***	6.57
Technological know. comp.	→	Innovation capability	0.72***	15.24			0.72***	15.24
Technological know. comp.	→	Organizational performance	0.21*	2.35	0.41***	5.85	0.62***	11.17
Innovation capability	→	Organizational performance	0.57***	6.65			0.57***	6.65
Goodness of fit statistics		χ^2_{226} = 392.14(p > 0.01); ECVI = 2.46; AIC = 492.14; CAIC = 707.30; NFI = 0.98; NNFI = 0.99; IFI = 0.99; PGFI = 0.58; PNFI = 0.87; NCP = 166.14; RFI = 0.99; CFI = 0.99; RMSEA = 0.06						

Notes: Standardized structural coefficients.*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table VI. Structural model results (direct, indirect, and total effects)

less than or equal to the significance level established, conventionally 0.05. If the p-value is less than the significance level, the starting hypothesis is most likely false. In this study, all hypotheses show a p-value of less than 0.05, indicating a positive relationship between the variables analyzed. Thus, *H1*, which predicted a positive relationship between SMT and TKC, is strongly supported ($\gamma_{11} = 0.60$, $p < 0.001$). *H2*, which predicted a positive relationship between TKC and organizational performance ($\beta_{31} = 0.21$, $p < 0.05$), is also supported. Furthermore, we show an indirect effect of TKC through innovation capability (0.72×0.57) on organizational performance (0.41, $p < 0.001$). The total influence of TKC on organizational performance is 0.62 ($p < 0.001$), as *H2* predicted. The results support *H3* that TKC are positively related to innovation capability ($\beta_{21} = 0.72$, $p < 0.001$). Finally, the relationships between innovation capability and organizational performance ($\beta_{32} = 0.57$, $p < 0.001$) were supported, as *H4* predicted. Globally, TKC ($R^2 = 0.36$), innovation capability ($R^2 = 0.52$), and organizational performance ($R^2 = 0.54$) are well explained by the model.

R^2 values for all endogenous constructs exceed 10 percent, implying a satisfactory and substantive model (Hair *et al.*, 2009).

The results also show that innovation capability is influenced indirectly by SMT (0.43, $p < 0.001$) through TKC (0.60×0.72). Likewise, organizational performance is influenced indirectly by SMT (0.37, $p < 0.001$) through TKC (0.60×0.21) and by TKC-innovation capability ($0.60 \times 0.72 \times 0.57$). Comparing the magnitudes of these effects shows that the effect of TKC on organizational performance is larger than that of innovation capability or SMT on organizational performance. Table VI presents the direct, indirect, and total effects.

Finally, the research investigates possible moderating effects of size or sector in the relationships analyzed, following two steps recommended by Jaccard and Wan (1996) and recommendations by Baron and Kenny (1986). The first step is multi-sample estimation without imposing restrictions, estimating the coefficients of the structural part of the model and this model's fit. Overall fit of the multi-sample model is good. Second, the research imposes restriction of equal regression coefficients in each subsample to confirm the presence/absence of significant differences between parameter estimations. Results show that neither size ($\Delta\chi^2 < 1.82$, $\Delta df = 1$, $p > 0.1$) nor sector ($\Delta\chi^2 < 1.03$, $\Delta df = 1$, $p > 0.10$) was significant, and size or sector did not modify relationships between the study variables.

Comparing alternative models' fit to that of the proposed model (comparing goodness of fit indices) can show that the hypothesized model best represents the data (Bollen and Long, 1993; Hair *et al.*, 2009). Table VII illustrates this comparison. For example, comparing Model 1 (structural proposed model) to Model 3, we see that, despite similar fit indices across the two models, omitting the direct path did not significantly improve model fit ($\Delta\chi^2 = 14.47$, $\Delta df = 1$, $p > 0.1$) and the third model has a worse RMSEA ($\Delta = 0.002$), AIC ($\Delta = 12.47$), ECVI ($\Delta = 0.06$), and NCP ($\Delta = 13.47$). The proposed model is thus the most acceptable and parsimonious. Table VII analyzes other comparisons to alternative proposed models.

6. Conclusions

6.1 Relations to previous findings and concluding remarks

Current dynamic environments with hyper-competitive conditions make disruptive innovations indispensable to improved organizational performance (Dodds *et al.*, 2003; Kocoglu *et al.*, 2012; Lyytinen and Rose, 2003). Drawing on complexity science, we developed a conceptual framework to explain how social media, as emergent phenomena, help firms create business value, leveraging network effects and knowledge flows. Our results confirm that using social media establishes valuable connections that transform business models by changing the way different agents and organizations communicate. Such change, in turn, creates a vast array of new opportunities – internal and external – for firms (Aral *et al.*, 2013). Promoting TKC in technological companies, social media thus promote organizational performance, directly and indirectly, through innovation capability.

Social media provide the source and distribution platforms that contribute to information transfer for continuous growing knowledge and enable a more participatory, interactive learning experience (Salem *et al.*, 2017; Scott, 1991). Interactive learning experience enables combinative or cooperative competencies based on technological knowledge, which appears to result from the firm's current store of information and know-how, learning capacity, and

Model	Description	χ^2	$\Delta\chi^2$	RMSEA	NFI	CFI	ECVI	AIC	NCP
1	Theoretical	392.14		0.061	0.98	0.99	2.46	492.14	166.14
2	W.R. tech. know. comp. to org. performance	398.09	5.95	0.061	0.98	0.99	2.48	496.09	171.09
3	W.R. innovation cap. to org. performance	406.61	14.47	0.063	0.98	0.99	2.52	504.61	179.61

Notes: $n = 201$. W.R. without relationship

Table VII.
Model statistics against theoretical model

organizing and technological opportunities (Kogut and Zander, 1992; Tyler, 2001). In the field of technology, all of the foregoing helps to explain the role of TKC in information processing, communication, or trustworthiness, and the success of all three in fostering technological innovation (Henderson and Cockburn, 1994; Tyler, 2001).

Consequently, we assert that the firm's TKC are positively related to proficient technological development of new products and processes. The latter are, in turn, linked to positional advantage in product differentiation, such as more innovative activity in the current environment (Lengnick-Hall, 1992; Song and Parry, 1997; Teece, 1986). Similarly, interactive learning experience in the field of technology provides a knowledge base from which to develop innovations. The firm's innovative capability depends on the situation and individuals through which technological learning emerges. The breadth, depth, and speed of technological learning thus leverages ability to integrate organization-specific TKC, equipping actors in the technological learning process to adapt quickly to changing environments (Lin, 2003; Zahra *et al.*, 2000).

Finally, this study suggests that organizations that exploit these aspects effectively (social media connections or TKC and innovation capability development) in their innovation processes can expect successful innovation activities that improve the organization's overall long-term performance. As an implication, the framework provides a foundation to assist both academics and practitioners in understanding the essence of innovation capability and how to link it to business objectives (Saunila and Ukko, 2012). In high-tech firms, social media stimulate, facilitate, and enhance organizational knowledge creation and innovation to produce higher company performance (Tyler, 2001).

6.2 Implications

6.2.1 Implications for researchers. Little research has analyzed which cooperative competencies (through social media) are used increasingly by academics to explain differences in competitive advantage and performance between firms (Real *et al.*, 2006). This paper sheds some light on this question, extending knowledge in the field. It shows that SMT have the potential to provide detailed, specific up-to-date knowledge (Nguyen *et al.*, 2015; Salem *et al.*, 2017) and information-sharing facilities, operate ubiquitously in networked computing environments, capture and reuse knowledge, provide tracking and monitoring of collaborative processes, produce collaborative design applications with continuous information exchange, permit use of TKC that supply needed data and information to workgroups whose members share information without constraints of space and time, and integrate and execute various components of problem-solving and decision-making processes from the user's desktop (Guo *et al.*, 2015).

SMT can thus improve TKC throughout the company in a remarkably efficient way, since all workers (employees and managers) from different groups can express opinions on a topic simultaneously, dramatically shortening decision-making processes compared to organizations that must meet or challenge agreements to make decisions.

Increasing TKC can also make the company entrepreneurial, stimulating it to find new opportunities or innovative ideas where other companies do not recognize them (Woolley, 2010). New innovative processes, actions or products require close management to increase workers' innovative capability, as well as their TKC and that of the company – a capability that increases performance. We show that the company will not develop structured organizational innovation capability if it does not understand how workers are connected to business performance.

6.2.2 Implications for managers. Our previous findings suggest some implications for managers. First, SMT can leverage connectivities within a company to improve its business activities. Moreover, effective connectivity is dynamic and positioned to develop

TKC for negotiating to suit the firm's strategy and successfully outperform competitors (Aral *et al.*, 2013; Kane *et al.*, 2014). Since SMT improve company TKC efficiency and effectiveness by adopting and improving its overall knowledge management process, a participatory culture will emerge from ubiquitous digital devices and social networks, as will balance among the constant connectivity afforded by digital devices. These actions take perfect advantage of big data and cloud computing to customize technological programs, helping colleagues to understand the relative advantages of implementing new technologies, their relative simplicity and ease of use, and their dependence on experimentation with and revision of observable results to achieve higher performance (Combs and Meskó, 2015; Leonardi *et al.*, 2013; Von Sheel *et al.*, 2015).

Second, it is highly likely that developing TKC within a firm will decrease the costs and risks of internal development, enable transfer of tacit knowledge, enhance knowledge accumulation and technological capability, and shorten time required to access the latest technologies on the market. TKC development also creates synergy for internal technology development, making better use of labor, equipment, and materials, producing financial savings and improvements in product quality, processes, outputs, operations, and reliability through use of information technology such as real-time decision support (Chesbrough, 2003; Guo *et al.*, 2015; Inkinen *et al.*, 2015; Kocoglu *et al.*, 2012; Tsai *et al.*, 2011). It is very likely that firms will achieve TKC by applying connected processes (Danneels, 2007, 2008; Real *et al.*, 2006), which design workflows to create and coordinate information. Connected processes also design decisions that affect common services such as groupware, database management, and authentication and security (Sharma, 1995). Furthermore, a process that is well orchestrated through SMT increases knowledge competence of company technology and firms' performance through more efficient communication among workers.

Finally, we observe not only that it is not enough to know how many opportunities for new innovative processes, actions or products have been missed, when workers lack the specific capabilities to be innovative (Saunila and Ukko, 2012). We have also advanced the literature by asserting that TKC enable excellent company innovative capability through proper development of leadership, decision-making processes, organizational structures and communication, collaboration and external links, organizational culture and climate, and individual creativity and know-how (Jaakson *et al.*, 2011). These capabilities encourage stronger organizational performance.

6.3 Research limitations and future research lines

First, it is advisable to perform repeated observations of the study variables over long periods of time. Longitudinal study enables monitoring of the same companies over time to reduce possible biases in cross-sectional studies. This study attempts to reduce this limitation, first by analyzing the theoretical relationship between the variables and then by integrating a temporal dimension in formulation of the questions (Garrido-Moreno *et al.*, 2014). This study also used a sample of Spanish firms in the technological sector. Future research should include other countries and sectors. All of these measures would enhance generalization of results to other research contexts or populations.

Second, this study used different tests to demonstrate that common method variance was not a problem. Anonymity, clear communication of goals, interviews to obtain qualitative information, use of previously validated scales, randomizing the order of survey items, using aggregate data, Harman's one-factor test, and CFA demonstrated that common method variance did not threaten the results (Podsakoff *et al.*, 2003). The key informants were CEOs, the employees who have the most comprehensive knowledge of the organization's characteristics and who analyze strategic variables and information about how the organizational system operates (García-Morales *et al.*, 2014). Nevertheless, future studies should collect data from other levels of management, employees, and organizational stakeholders (e.g. suppliers, customers, competitors) to deepen understanding of the interrelations studied.

Third, our research analyzes the relationship between SMT and organizational performance through TKC and innovation capability. Although it explains an acceptable proportion of the variables innovation capability (57 percent) and organizational performance (55 percent), futures studies on the impact of other ICT and knowledge management in business innovation ecosystems and organizational performance are welcome. Other antecedents and drivers for developing business innovation ecosystems such as organizational learning (Senge *et al.*, 1999) and absorptive capacity (Jiménez-Barrionuevo *et al.*, 2011) should be analyzed.

Finally, little literature focuses on a digital vision from a social media perspective. Future research should analyze how to manage these inter- and intra-organizational networks, and the emergence of new SMT as a strategic element for management of organizations seeking to improve their knowledge resources. Analysis of how to apply these technologies to achieve optimal innovation ecosystems to improve organizations' competitive advantage is also needed (Jarvenpaa and Tanriverdi, 2003).

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