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The role of knowledge-oriented leadership in knowledge management practices and innovation

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ABSTRACT

This study aims to examine the role of a specific type of organizational leadership – knowledge-oriented leadership – in knowledge management (KM) initiatives that seek to achieve innovation. An analysis of the knowledge-based view of the firm gives rise to several hypotheses, with structural equation modeling (SEM) analysis through partial least squares (PLS) providing the methodology to test these hypotheses. This approach yields results for a sample of empirical data from technology industries. This paper presents empirical evidence of the mediating effect of KM practices in the relationship between knowledge-oriented leadership and innovation performance. In line with previous literature, results show that, although KM practices themselves are important for innovation purposes, the existence of this kind of leadership encourages the development and use of KM exploration (i.e., creation) and exploitation (i.e., storage, transfer, and application) practices. A major implication is that, as a result of this development and the use of KM practices, the firm is able to improve its performance in product innovation.

1. Introduction

Emerging in the nineties, knowledge management (KM) is a well-established discipline in the academic field and business world alike. Based on the principles of KM, organizations worldwide develop and implement KM initiatives to improve the efficiency of business processes, increase the productivity and quality of their services, and find new solutions and products for their customers (Nguyen & Mohamed, 2011). Moreover, in technological settings, innovation is usually a direct outcome of KM effectiveness (Darroch & McNaughton, 2002; Du Plessis, 2007) as well as being one of the main objectives for knowledge-creating companies in their pursuit of competitive advantages (Nonaka & Takeuchi, 1995).

Although the importance and use of KM for organizations is unquestionable, recent reports such as Bain's Management Tools and Trends 2011 reveal low satisfaction rates among managers in relation to both the use of this management tool and the results of its application (Rigby & Bilodeau, 2011). In general, the design and implementation of KM practices are a difficult task for managers, and the effectiveness and success of such practices depend heavily on their optimal adjustment to organizational factors (Bierly & Daly, 2002). Consequently, managers should establish the ideal contextual conditions to propel and optimize the organization's use of KM practices and initiatives through the design of tools such as human resource management (HRM) practices (e.g., Chen & Huang, 2009; Lin, 2011; López-Cabrales, Pérez-Luño, & Valle-Cabrera, 2009), setting well-defined corporate culture (e.g., DeTienne, Dyer, Hoopes, & Harris, 2004; Donate & Guadamillas, 2010; Nguyen & Mohamed, 2011), the implementation of technology systems (e.g., King & Marks, 2008; Lai, Wang, & Chou, 2009; Lin & Huang, 2008) and the establishment of organizational structures (e.g., Gold, Malhotra, & Segars, 2001; Singh & Kant, 2009).

Leadership behavior is another important factor, since leaders have an enormous impact on the direction and effectiveness of KM within their organizations (Nguyen & Mohamed, 2011). On the one hand, leaders can create conditions that allow participants to exercise and cultivate their knowledge manipulation skills, to contribute their own individual knowledge resources, or to obtain easier access to relevant knowledge (Crawford, Gould, & Scott, 2003; Politis, 2002). On the other hand, leadership behaviors may present major barriers to creating and leveraging knowledge (Bryant, 2003; Politis, 2002; von Krogh, Nonaka, & Rechsteiner, 2012), as they can result in knowledge hoarding, competition – rather than cooperation – and a host of other negative attitudes for knowledge-creating companies (Lakshman, 2009; Yahya & Goh, 2002).

Despite the great importance of leadership in KM, researchers have only recently begun to explore the role of leaders in KM, relating specific

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management styles to good KM (Lakshman, 2009: 388). For example, Yang (2007) associates *innovator*, *mentor* or *facilitator* roles with high levels of knowledge sharing. Similarly, Singh (2008) finds that a delegating as opposed to a directive – high level of control over employees and low level of nurture – leadership style has a positive relationship with all KM practices in technological settings. In a more recent work, von Krogh et al. (2012) develop a framework for situational leadership in knowledge creation by integrating notions such as Ba – the environment for knowledge creation – the SECI model, knowledge assets and leadership behaviors (Nonaka & Konno, 1998; Nonaka & Takeuchi, 1995). These authors also stress the necessity to carry out additional research to clarify the role of organizational leadership in KM activities and processes.

Following this suggestion, this paper focuses on organizational leadership as an essential condition for the development and encouragement of KM practices for innovation purposes in technology-intensive firms. As competitive advantages for these companies essentially equate to new product development, such firms need to explore and exploit knowledge assets in a quick, effective, flexible manner (DeCarolis & Deeds, 1999; Subramaniam & Youndt, 2005). This study specifically aims to address the following research question: how can companies take full advantage of KM initiatives in innovation through organizational leadership? In doing so, this paper addresses three main objectives: (1) to analyze the influence of a specific type of organizational leadership – knowledge-oriented leadership – on KM practices (i.e., creation, transfer, storage, and application); (2) to analyze the effect of KM practices on product innovation performance; and (3) to explore the mediating role of KM practices in the relationship between knowledge-oriented leadership and performance in product innovation.

In meeting these objectives, this paper contributes in several ways to this research field. First, researchers rarely consider connections between three separate bodies of literature such as leadership, KM, and innovation. Forging links between these three areas is the principal focus of this study. In this vein, this paper introduces and tests a theoretical model that links these concepts. Several existing studies cover the theoretical and empirical analysis of relations between leadership, innovation, and specific KM processes (e.g., Singh, 2008; von Krogh et al., 2012; Yang, 2007). Nonetheless, a considerable gap remains in the study of the general leadership conditions that allow knowledge-intensive companies to explore and exploit organizational knowledge simultaneously to achieve competitive advantages from innovation. This research thus makes strides toward filling this gap by studying what kind of leadership is most adequate to fully develop and support these KM initiatives in innovation.

Second, this research examines the effect of a distinctive type of leadership behavior – *knowledge-oriented* leadership – on the KM initiatives that attract the most universal acceptance in the KM literature. Knowledge-oriented leadership includes knowledge creation, transfer, storage, and application (Alavi & Leidner, 2001). This article adopts a more ambitious scope than that of the existing literature on KM leadership styles, by offering a measure for knowledge-oriented leadership, a factor that affects KM activities in technology-intensive firms (i.e., companies that need to both explore and exploit knowledge to confront changes in the market rapidly and flexibly) (Jansen, Van Den Bosch, & Volberda, 2006). While the leadership literature mainly focuses on specific leadership styles that fit with either explorative or exploitative innovation or specific KM initiatives (e.g., Mumford, Scott, Gaddis, & Strange, 2002; Singh, 2008; Yukl, 2009), this paper stresses the role of a general, knowledge-oriented form of leadership that simultaneously supports both explorative (i.e., creation) and exploitative (i.e., storage, transfer, and application) initiatives; an approach that extant KM studies have yet to adopt. This paper thus contributes to current research into which organizational elements support ambidextrous organizations (Miller, Bierly, & Daly, 2007; Raisch & Birkinshaw, 2008).

Third, this paper contributes to research by presenting a comprehensive model that captures the relationships between KM practices and knowledge-oriented leadership. Statistical testing of the model through partial least squares (PLS) path analysis provides an indication as to the model's utility. Although the idea of ambidextrous organizations (i.e., organizations with the capability of exploring and exploiting knowledge equally well) is hardly a new concept, Rosing, Frese, and Bausch (2011) point out that applications of organizational ambidexterity in organizational leadership are rare. In this regard, the current study works under the assumption that innovation leaders need to switch flexibly between complementary leadership behaviors in an attempt to adjust to the requirements of both explorative and exploitative KM activities. Knowledge-oriented leadership is thus a necessary instrument that is based on a mixture of transformational and transactional leadership styles, along with communication and motivational elements (Ribiere & Sitar, 2003). Overall, the arguments in this paper demonstrate that this kind of organizational leadership is necessary for technology-intensive organizations to improve their innovation performance through the effective development and implementation of KM initiatives.

The paper has the following structure. A discussion of the theoretical background and research questions under study follows this introductory section. Next, the third section presents the methodology and main results of the statistical analysis. Finally, the paper closes with a discussion of the research findings and the principal conclusions of the study.

2. Theoretical background and hypotheses

2.1. Knowledge-based theory and knowledge management

Recent work in the Economics and management literature is contributing to developing a knowledge-based theory of the firm, which cites the primary reason for the existence of firms as being the creation, integration, and utilization of knowledge (Grant, 1996; Kogut & Zander, 1992). The knowledge-based view (KBV) has its roots in the resource-based view of the firm, which focuses on strategic assets as the main source of competitive advantages (Amit & Schoemaker, 1993). In contrast, under the KBV, knowledge is the main strategic resource, which, when properly managed, allows the firm to create value from its exploitation of production (DeCarolis & Deeds, 1999; Zack, McKeen, & Singh, 2009). Accordingly, the firm is the embodiment of a knowledge-bearing entity that manages its knowledge resources through its combinative–dynamic capabilities (Kogut & Zander, 1992). Nevertheless, as Argote and Ingram (2000: 156) point out, "the problem for those who want to develop competitive advantage for their organizations, however, is that, in the field of business strategy, more effort has gone into identifying knowledge as the basis of competitive advantage than into explaining how organizations can develop, retain, and transfer that knowledge."

Therefore, companies should develop and implement a series of activities or initiatives to help deploy their organizational capability and extract value; in other words, they should adopt so-called KM practices (Grant, 2002). The main goal of an organization's use of KM is to gain awareness of its knowledge, individually and collectively, and to shape itself in such a way as to make the most effective and efficient use of the knowledge the firm has or is able to obtain. Alavi and Leidner (2001) point out that the use of KM practices, frequently relying on information and communication technologies (ICTs), leads to positive organizational outcomes such as enhanced communication and higher levels of participation among staff members, efficiencies in problem solving and time-to-market, more favorable financial performance, better marketing practices, and improved project team performance, hence the widespread acknowledgement of the contributions of KM to an organization's overall success. Nonetheless, in technology-intensive industries where competitive advantage depends heavily on

the capability of firms to continually develop new products or processes, innovation seems to be the most important challenge for KM (Nonaka & Takeuchi, 1995; Raisch & Birkinshaw, 2008; Subramaniam & Youndt, 2005).

This paper's focus is on product innovation as one of KM's essential goals for firms in technological, knowledge-based settings (Nonaka & Takeuchi, 1995; Yahya & Goh, 2002). The discussion below explains the relationships between KM initiatives and innovation, going on to cover their links to knowledge-oriented leadership.

2.2. KM practices and innovation

KM is a set of activities, initiatives, and strategies that companies use to generate, store, transfer, and apply knowledge for the improvement of organizational performance (Alavi & Leidner, 2001; Zack et al., 2009). Explorative initiatives mainly seek to create new knowledge, whereas exploitative practices aim at leveraging existing knowledge stocks via the transfer, sharing, and application of such resources (Grant, 2002; March, 1991).

Knowledge creation involves developing new knowledge content or replacing existing content in the organization's explicit or tacit knowledge pool (Alavi & Leidner, 2001). KM creation activities typically relate to the internal development of knowledge through R&D (Darroch & McNaughton, 2002). Nevertheless, at the same time that organizations create knowledge and learn, they may forget or lose track of their acquired knowledge (Alavi & Leidner, 2001). Thus, KM storage activities, which include the organization, structuring, and retrieval of organizational knowledge, allow the firm to maintain an organizational memory, which encompasses knowledge that resides in various forms such as written documentation, information stored in electronic databases, codified human knowledge stored in expert systems, documented organizational procedures, and processes or tacit knowledge acquired by individuals and networks of individuals (Alavi & Tiwana, 2003; Zack, 1999). Moreover, KM transfer activities permit organizational members to share, disseminate, and replicate information, spreading this information to locations that need and can put to good effect the company's existing knowledge. To do so, the company should establish communication channels, which may be informal, formal, personal, or impersonal (Alavi & Leidner, 2001). Finally, knowledge application implies the integration of knowledge from different sources to develop organizational capability through mechanisms based on routines, norms, or decision-making in specific situations (Grant, 1996). KM application practices should thus focus on making the integration and application of existing knowledge to organizational activities and problem solving easier and more effective for the firm (Grant, 1996; Zack et al., 2009).

Effective KM emerges in the literature as a method for improving the firm's innovation capacity. For instance, through an extensive review of studies analyzing the KM–innovation relationship, Darroch and McNaughton (2002) conclude that KM generation practices generally share an association with innovation performance. In this regard, numerous scholars find positive connections between R&D efforts to generate new ideas and innovation (e.g., Capon, Farley, Lehman, & Hulbert, 1992; Zahra & Bogner, 1999). Other lines of research also illustrate a positive link between the acquisition of market knowledge or knowledge from employees, and innovation (e.g., Li & Calantone, 1998; Lynn, Reilly, & Akgun, 2000). According to these findings, KM practices that promote the generation of new knowledge and organizational learning are fundamental for achieving advantages based on innovation (Zack et al., 2009). These practices basically deal with learning through processes of concerted variation, planned experimentation, and play (Baum, Li, & Usher, 2000). KM based on internal R&D practices for knowledge creation (e.g., investment in equipment, hiring and training research personnel, and research project assessment) is thus necessary for the firm to improve its innovation performance. The first hypothesis of the study is thus the following:

H1. *KM creation practices have a positive relationship with the company's innovation performance.*

Moreover, Darroch and McNaughton (2002) point out that the studies linking knowledge exploitation and innovation yield mixed results. As Kazanjian, Drazin, and Glynn (2000) state, knowledge transfer and application are essential success factors for new product development, although they still present key challenges for a number of organizations. In general, the way an organization utilizes its existing knowledge through KM practices determines this knowledge's utility in innovation (Brockman & Morgan, 2003). For example, studies show that socialization practices, both formal and informal, have an impact on knowledge sharing and improve product development outcomes (Lawson, Petersen, Cousins, & Handfield, 2009). Specifically, knowledge dissemination and application emerge as two characteristic components of KM with major potential for the generation of sustainable competitive advantages based on innovation, due to their complexity, ambiguity, and uniqueness to the firm (Fahey & Prusak, 1998; Grant, 1996).

According to these arguments, the greater the availability of KM transfer and application practices for disseminating, integrating, and applying organizational knowledge, the better a firm's innovation performance will be. So the second and third hypotheses are the following:

H2. *KM transfer practices have a positive relationship with the company's innovation performance.*

H3. *KM application practices have a positive relationship with the company's innovation performance.*

Although the current research approach treats storage as a knowledge-exploitation process, this study considers the link with results in innovation to be indirect. In general, evidence of the direct effect of codifying or making knowledge explicit in databases or organizational reports on innovation is non-existent (Darroch & McNaughton, 2002). ICTs, however, which are at the core of storage practices, facilitate knowledge transfer and its application in organizations (Cummings & Teng, 2003; Lai et al., 2009). For instance, Purvis, Sambamurthy, and Zmud (2001) refer to knowledge platforms as repositories of codified knowledge that permit the company to transfer, use, and integrate knowledge modules for improving the execution of ongoing tasks related to the innovation process, which leads to new technologies. Moreover, Ren, Carley, and Argote (2006) empirically show how firms are able to obtain improvements in the quality of product technologies from the interaction between knowledge storage and transfer practices whose structure revolves around the so-called transactive memory. This term refers to the use of certain values, common to all members of a group, that identify the organizational members who possess knowledge on a specific subject. In addition, Lai et al. (2009) find that knowledge management systems are more useful for knowledge sharing and transfer when the firm develops personalization strategies and an adequate mapping of knowledge in storage devices.

As knowledge storage practices are about filing, structuring, or gathering data and information, their effect on performance becomes noticeable when organizational members with a specific aim transfer or apply these initiatives (Argote & Ingram, 2000; Cummings & Teng, 2003). When their implementation is in conjunction with KM transfer and application practices, knowledge storage practices are likely to affect a firm's innovation results. Moreover, knowledge transfer or application initiatives may be more effective if their usage is in conjunction with adequate knowledge gathering and structuring in databases or other technical devices (Alavi & Leidner, 2001). Knowledge transfer and application will thus have a mediating role between knowledge storage

practices and innovation performance. Hypotheses four and five are thus the following:

H4. *Knowledge storage practices indirectly affect the company's innovation performance, through their positive relationship with KM transfer practices.*

H5. *Knowledge storage practices indirectly affect the company's innovation performance, through their positive relationship with KM application practices.*

2.3. Leadership, knowledge management, and innovation

Dessler (2001) describes leadership as a way of inspiring others to work hard to accomplish important tasks. Leadership thus involves defining a clear management approach toward employees and encouraging them to follow the leader to achieve the firm's goals. Ribiere and Sitar (2003) add that leadership consists of several elements that include leadership style, motivation, and communication. Leadership in knowledge organizations is particularly relevant when knowledge workers perceive leaders as actively engaging and committing to supporting knowledge and learning activities (DeTienne et al., 2004). Moreover, knowledge leaders should recognize and reward such attempts by their co-workers (Ribiere & Sitar, 2003: 44), instead of promoting negative behaviors that jeopardize knowledge transfer, sharing, and application (Lakshman, 2009).

Ribiere and Sitar (2003) point out that, in order to take advantage of knowledge exploration and exploitation processes, organizational leadership in knowledge-intensive companies means leading through a knowledge lens. In other words, leaders of a company must guide knowledge workers to learn and use knowledge, thereby achieving the knowledge goals of the firm as a whole. Knowledge-oriented leadership thus implies affording KM a prominent role in the firm so as to sense and seize opportunities to innovate (Teece, 2009). In this regard, knowledge-oriented leaders should champion the development of KM channels and initiatives for both knowledge exploration and knowledge exploitation. Moreover, they should promote best KM practice in the company, essentially through an effective KM leadership style, motivation, communication, and staffing.

Regarding leadership style, Ribiere and Sitar (2003) suggest that for the firm to boost its innovation, knowledge leaders should bring together divergent behaviors, depending on the demands of each situation. As highly innovative firms have to combine exploration and exploitation initiatives to attain organizational ambidexterity (Raisch & Birkinshaw, 2008) they should be able to lead members toward objectives in different contexts with distinct task requirements (Rosing et al., 2011). In this regard, Williams and Sullivan (2011) show their skepticism toward the merits of the traditional, heroic, transformational leader in a learning context, instead advocating alternative kinds of learning leaders, who build knowledge organizations by combining transactional (focused on leader–follower exchanges in the form of benefits, rewards, incentives, and self-interest) and transformational (focused on the motivation and inspiration of followers to give their best) behaviors. In this vein, Ho (2009) emphasizes the role of leaders as both developers and facilitators of KM who plan knowledge processes and foster their implementation through reward systems. Interestingly, Rowe (2001) suggests that, to manage both explicit – through its exchange and combination – and tacit knowledge – through its communication and use – in innovative contexts, the firm needs a mixture of managerial (i.e., transactional and instrumental) and visionary (i.e., transformational and role modeling) leadership styles. Rosen, Furst, and Blackburn (2007) also contemplate this integrative perspective by considering role-modeling leadership (leading by example), vision articulation, clarification of leaders' expectations of their followers, recognition, and rewards to be focal aspects.

In general, this mixture of knowledge leadership behavior should propel KM initiatives of creation, transfer, storage, and application within the firm. Moreover, knowledge-oriented leadership should encompass clear communication regarding the expectations of knowledge employees and the company's objectives, along with motivational elements (Ribiere & Sitar, 2003). In the first place, leaders must act as advisers so that the firm's employees are able to recognize how their job and KM initiatives contribute to ensuring communication. Furthermore, communication is essential for leaders to clearly show employees the company's expectations in terms of their work, and eliminate communication barriers (Schermerhorn, 2012). Without managers stressing the importance of KM initiatives, employees will assume that KM is of little importance (DeTienne et al., 2004).

Motivation is an additional element for knowledge-oriented leadership. A number of studies (see e.g., Bollinger & Smith, 2001; Bryant, 2003; Chang, Hsu, & Yen, 2012) show that both implicit (e.g., role modeling) and explicit (e.g., rewards) motivation have positive relationships with KM development and success. One of the most important tasks for leaders is to recognize that diverse motivational factors influence different individuals. Leaders should therefore use a range of approaches depending on organizational members' preferences (Dessler, 2001). Knowledge-oriented leadership should also consider the nature of each KM initiative to assess results and motivate knowledge workers depending on the nature of a given KM practice. For instance, knowledge transfer or sharing may call for group-implicit incentives, whereas articulation and knowledge storage are more effective when workers are subject to individual, tangible incentives (DeTienne et al., 2004).

As the above discussion explains, knowledge-oriented leadership in KM development combines aspects of transformative and transactional leadership styles, in addition to including motivation and communicational elements. The main goals for a knowledge-oriented manager are to act as a role model, encourage learning by challenging workers and stimulating them intellectually, institutionalize learning through the provision of incentives and training, foster a pro-learning culture that tolerates mistakes and encourages cross-functional and -discipline engagement, and develop knowledge transfer, storage and application mechanisms (Williams & Sullivan, 2011). For KM creation, knowledge-oriented leadership creates conditions that are conducive to a greater commitment to R&D activities for experimentation and creative learning. In knowledge-intensive companies, role modeling engenders a common sense of higher purpose to place innovation as an aspiration that applies to both leaders and followers (von Krogh et al., 2012). Moreover, motivational elements and specific rewards for these activities help the firm create the appropriate conditions and develop initiatives for knowledge sharing and knowledge conversion that lead to new ideas (Nonaka & Takeuchi, 1995). A similar reasoning applies to KM exploitation activities. In this case, knowledge-oriented leadership, through a more transactional perspective, is likely to intensify willingness to exploit existing knowledge (Miller et al., 2007) through the development of initiatives of storage (i.e., to remember what the company already knows), transfer (e.g., to take advantage of knowledge in other locations), and application (e.g., to integrate pieces of knowledge). Again, the perspective that motivational and communication elements affect the effectiveness of these exploitation initiatives increases the willingness to develop KM storage, transfer, and application practices.

This study thus establishes the hypothesis that, when a company has a greater inclination toward knowledge-oriented leadership, the firm more intensively encourages the development and use of KM practices. In other words, knowledge-oriented leadership has a direct effect on KM practices of creation, transfer, storage, and application.

H6. *Knowledge-oriented leadership has a positive relationship with the company's KM practices.*

H6.a. *Knowledge-oriented leadership has a positive relationship with the company's KM creation practices.*

H6.b. *Knowledge-oriented leadership has a positive relationship with the company's KM transfer practices.*

H6.c. *Knowledge-oriented leadership has a positive relationship with the company's KM storage practices.*

H6.d. *Knowledge-oriented leadership has a positive relationship with the company's KM application practices.*

Existing research on innovation leadership in KM contexts offers inconclusive results on how to establish leadership to exert a major impact on innovation (von Krogh et al., 2012). The above discussion sets out arguments in support of the existence of positive relationships between KM practices and innovation. As knowledge-oriented leadership serves as a driving force for KM initiatives, this leadership style will share an indirect connection with innovation performance. Specifically, the greater the firm's level of knowledge-oriented leadership, the more the firm will develop KM practices, which, in turn, will positively affect innovation performance. Hypothesis seven is thus established and figure 1 shows the research model with KM practices mediating the relatioship between knowledge-oriented leadership and innovation performance.

H7. *KM practices mediate the relationship between knowledge-oriented leadership and the company's innovation performance.*

3. Research methodology

3.1. Population, sample, and data collection

This study employs survey methodology to gather primary data for empirical analysis. A selection of technology firms makes up the sample, since these companies tend to be sensitive to the use of both exploration and exploitation practices (He & Wong, 2004), and innovation plays a pivotal role in their strategies for gaining competitive advantages (Grant, 2002; Jansen, Vera, & Crossan, 2009. Moreover, technology companies probably have a broader spectrum of KM strategies than non-technology firms, place a greater emphasis on the management of both explicit and tacit knowledge, and consider the technical (IT-based KM strategies) and humanistic (personalization strategies) perspectives of KM. In addition, knowledge organizations from technology-intensive industries require a different management approach from non-knowledge organizations, and the role of leadership and HR management should be distinctive and supportive of KM processes (Yahya & Goh, 2002).

The study's population comprises industrial companies from four innovative industries in the Spanish industrial classification CNAE-93, which are included in a homogeneous specific section (DL) that falls under the classification of manufacturing of electric, electronic and optical material and equipment: group 30 (manufacturing of office machines and computer equipment), group 31 (manufacturing of electric materials and machinery), group 32 (manufacturing of electronic material) and group 33 (manufacturing of medical–surgical, optical and watch-making materials). The INE (Spanish National Statistics Institute) classifies these industries as technology-intensive, which fits with the research goal of analyzing knowledge-based organizations. The universe of firms for the sample consists of those with more than 25 employees. The final population is 802 firms: 54.3% from the electrical materials and equipment industry, 25.6% electronic material industry, 3.4% office equipment industry, and 16.7% medical, surgical and optical material industry.

The data-collection processes involved compiling company data and information of interest (e.g., the companies' addresses, senior management team identification, and secondary data) into an ad hoc database specifically for this research project. Databases used to gather the companies' information were: Fomento de la Producción 30,000 (30,000-Manufacturing Promotion) and SABI (Analysis System of Iberian Accounts). To collect primary data, 802 firms received a postal questionnaire, whose design owes to the results of a detailed literature review on measurement scales, and which contains questions that address KM, innovation and strategy. A letter accompanied the questionnaire, requesting senior managers or executives who were familiar with the topic of this study to complete the questionnaire.

Before launching the survey, rigorous pretesting through personal interviews with executives of five technology-intensive companies and a number of academics took place to validate the questionnaire. These interviews provided an opportunity to improve the quality of items and correct wording issues. Finally, two questionnaire mailings (the second mailing in May 2005, one month after the first one) yielded 111 usable questionnaires, representing a 13.8% response rate. The majority of the respondents are CEOs, human resource directors, or technology management directors. Respondent firms have, on average, 33.6 years of longevity (SD = 23.8) and an average size (number of employees) of 275.3 (SD = 565.2).

Analysis of differences between respondents and non-respondents for a given set of variables tests for non-response bias. T-tests reveal no significant differences between the two groups in relation to size ($t = 0.705$; $p < 0.91$) or age ($t = 0.927$; $p < 0.74$). The analysis also fails to yield significant differences regarding the industry distribution of the sample and that of the entire population.

Since all data come from a single self-report questionnaire with a cross-sectional research design, common method variance – variance arising from the measurement method rather than the constructs of interest – may cause systematic measurement error and bias in the estimation of the true relationship among theoretical constructs (Podsakoff & Organ, 1986). The Harman one-factor test (through exploratory factor analysis) checks for the existence of

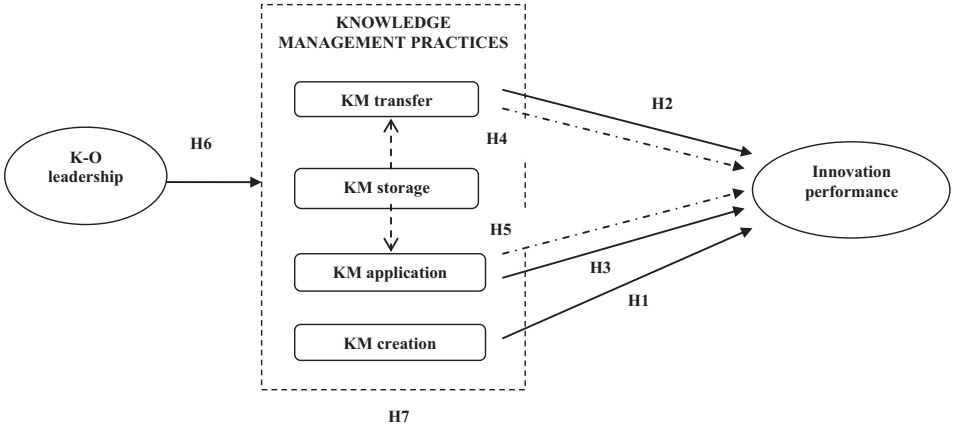

Fig. 1. Research model.

this problem. For this test, a substantial amount of common method variance is present if either (a) a single factor emerges from the factor analysis, or (b) one general factor accounts for the majority of the covariance among the variables (Podsakoff & Organ, 1986). Factor analysis (principal component analysis with varimax rotation) on the questionnaire items reveals the existence of six distinctive factors with eigenvalues greater than 1.0. These factors account for 67.2% of the total variance. Moreover, the first (largest) factor accounts for 28.4% of the total variance. Since more than one factor emerges and no general factor accounts for the majority of the total variance, common method variance is of little concern and is thus unlikely to confound the interpretations of the results in this study.

3.2. Measures

3.2.1. Knowledge management practices

At the time of this study, the KM literature had yet to establish general multi-item measures for KM practices constructs. Although multi-item measures for knowledge exploration and exploitation existed (see e.g., He & Wong, 2004), they were mostly related to radical or incremental innovations pursued by the firm rather than the development of KM practices or initiatives. So firstly, in the questionnaire, the characterization of knowledge-creation practices equates to the firm's effort to develop its knowledge base internally. From the innovation strategy literature, Zahra and Das (1993), with subsequent improvements from Zahra and Bogner (1999), provide a four-item measure (1 = strongly disagree; 7 = strongly agree) for adaption and use in this study (see Appendix A for a detailed listing of the items). These items mainly relate to R&D activities that permit the firm to generate new knowledge.

Secondly, multi-item measures allow for the collection of knowledge transfer, storage and application practices following previous research (see Appendix A for a detailed listing of the items). Adaptions of seven items for KM storage, eight for KM transfer, and five for KM application practices come from the previous studies of Davenport, DeLong, and Beers (1998), Alavi and Leidner (2001), Alavi and Tiwana (2003), Bontis, Crossan, and Hulland (2002), Gold et al. (2001) and Wang and Ahmed (2004). Items range from 1 = strongly disagree to 7 = strongly agree (see Appendix A for the rest of the items).

3.2.2. Knowledge-oriented leadership

A seven-point Likert scale with six items from the KM and leadership literature measures knowledge-oriented leadership (see Appendix A for a detailed list of the items). In addition to elements of communication and motivation, the items include both transformational and transactional styles, following this study's theoretical orientation toward leadership in knowledge-based organizations (Paul, Costley, Howell, & Dorfman, 2002; Ribiere & Sitar, 2003; Sadler, 2003). Items measure the conditions to promote responsible behaviors among employees and teams (Rosenbloom, 2000), the role of leaders as mediators for sharing and applying knowledge (Nonaka & Takeuchi, 1995; Pan & Scarbrough, 1999), the role of leaders for evaluating employees on the basis of tolerating errors and promoting learning rather than work output (Bollinger & Smith, 2001; Roth, 2003), the generation of expectations regarding the quality of the work of employees trying to promote creativity (Haas & Hansen, 2005; Roth, 2003), leading by example by assuming the role of knowledge managers (Bryant, 2003), and rewarding employees who share and apply knowledge (Pan & Scarbrough, 1999). The items range from 1 = strongly disagree to 7 = strongly agree (see Appendix A for the complete list of items).

3.2.3. Innovation performance

This measure is an adaptation of Zahra and Das's (1993) and Zahra and Bogner's (1999) measures, which refer to new product developments. Apart from absolutely subjective items (e.g., results of the company), this measure also includes relative items (e.g., results compared to those of competitors). Following Zahra and Das (1993: 24), relative measures are a necessary requirement, as innovation effectiveness depends heavily on comparisons (e.g., rivals' performance; previous years' results). Items range from 1 = very low to 7 = very high (see Appendix A for the list of items).

3.3. Statistical analysis and hypotheses testing

The study employs partial least squares (PLS) to analyze the research model. SmartPLS 2.0 (Ringle, Wende, & Will, 2005) provides the software to conduct the analysis. A variance-based PLS approach is preferable to covariance-based methods, since PLS impose less strict restrictions on sample size and distribution (Chin, Marcolin, & Newsted, 2003). PLS are an SEM technique that simultaneously assess a measurement model and the theoretical structural model (Chin, 1998). In addition, PLS are an adequate method to resolve multicollinearity problems that frequently appear in multivariate regression analysis, since PLS transform predictor variables to an orthogonal component (Chin et al., 2003). Although estimation of measurement and structural parameters occurs simultaneously, the application of a PLS model typically takes place in two stages. The first step is to estimate the measurement model using confirmatory factor analysis, to assess the reliability and validity of the theoretical constructs. Then, estimation of the structural model examines the (path) associations between the hypotheses in the research model.

The control variables in the model are: the firm's age (years from the firm's foundation), size (number of employees), industry category (three dummy variables, taking into account the four industry groups, with one as reference), and R&D spending (see Appendix A). As the inclusion of control variables in the structural model fails to bring about significant improvements, and the structural path parameters remain largely the same, the final analysis excludes control variables in favor of methodological parsimony.

3.3.1. Measurement model

Assessment of convergent and discriminant validity determines the validation of the measurement model. Convergent validity of the scales is contingent on the fulfillment of three criteria (Fornell & Larker, 1981; Hair, Anderson, Tatham, & Black, 1998): (1) all indicator loadings should exceed 0.65 (2) composite reliabilities should exceed 0.8; and (3) the average variance extracted (AVE) for each construct should exceed 0.5. As Table 1 shows, all the indicator loadings are above the recommended threshold, the CR values range from 0.87 to 0.95, and the AVE ranges from 0.55 to 0.82. All three conditions for convergent validity thus hold.

To evaluate discriminant validity, Fornell and Larker (1981) suggest that the square root of the AVE of a latent variable should be greater that the correlations between the rest of the latent variables. As Table 1 shows, discriminant validity holds for the model, as the square root of the AVE for each construct is greater than the correlations between the variables that form the construct.

3.3.2. Structural model

Prior to the hypotheses testing, cross validation (CV)-communality and -redundancy indices assess the quality of the structural model. The mean of the CV-communality indices confirms the global quality of the structural model if the indices are positive for all the blocks, taking into account the measurement model as a whole. In addition, the CV-redundancy index offers a metric to evaluate the quality of each structural equation. This index should be positive for all endogenous constructs (Tenenhaus, Esposito, Chatelin, & Lauro, 2008). For this study, the model demonstrates adequate predictive validity and fit, since all the latent variables have positive

Table 1
Descriptive statistics and convergent and discriminant validity.

Construct	Mean	S.D.	Range of loadings	CR	AVE	Correlation between constructs					
						Inn	KMc	KMa	KMs	KMt	KOL
Innovation (Inn)	5.34	1.07	0.81–0.89	0.94	0.75	**0.86**					
KM creation (KMc)	5.12	1.56	0.84–0.96	0.95	0.82	0.63	**0.91**				
KM application (KMa)	4.31	1.30	0.68–0.81	0.87	0.58	0.44	0.39	**0.76**			
KM storage (KMs)	5.26	1.14	0.65–0.83	0.90	0.55	0.30	0.17	0.56	**0.74**		
KM transfer (KMt)	4.60	1.37	0.71–0.85	0.93	0.63	0.28	0.30	0.64	0.62	**0.80**	
K-O leadership (KOL)	5.06	1.19	0.71–0.88	0.93	0.68	0.44	0.36	0.65	0.60	0.61	**0.82**

All loadings are significant with $p < 0.001$. The diagonal elements (in bold) are the square roots of the variance between the constructs and their measures (AVE). Off-diagonal elements are the correlations between the constructs.

values for cross validation (CV)-redundancy and -communality indexes (Table 2).

After analyzing the quality of the structural equation, the next step is to test the relations between all constructs. Consistent with Chin (1998), bootstrapping (500 subsamples) generates standard errors and t-values. Fig. 2 displays the results of the structural model analysis, showing the path coefficients along with their significance levels. Table 3 shows the decomposition of effects (total, direct, indirect). The results of the statistical model offer support for H1, H3, H6 and H7, and fail to corroborate H2, H4 and H5.

H1 predicts a positive impact from KM creation practices on innovation, which the analysis confirms. Diamantopoulos and Siguaw (2000) classify path coefficients that are below 0.30 as (causing) moderate (effects), from 0.30 to 0.60 as strong, and above 0.60 as very strong. Therefore, KM creation practices demonstrate a strong, positive, significant effect on innovation performance (path coefficient = 0.541, $p < 0.01$). The more a firm develops KM creation initiatives, the better its innovation performance. Similar results emerge for KM application practices, which also have a positive, significant effect on innovation performance (path coefficient = 0.307, $p < 0.01$). Hence, H3 also receives empirical support from the data.

Nevertheless, results fail to confirm that KM transfer has a direct relationship with the company's innovation performance, as the effect is statistically non-significant (path coefficient = –0 .109; $p > 0.05$). The results thus lead to the rejection of H2. Results also fail to yield empirical evidence for the relationships in H4 and H5, due to the non-significant t-values for the parameters (path coefficients = –0.051 and 0.082, $p > 0.05$, respectively). In conclusion, KM storage practices do not have a mediating effect in the relationship between innovation performance, and either KM transfer or application initiatives.

On the other hand, H6 obtains empirical support from the data. Therefore, the greater a company's orientation toward knowledge leadership, the greater its development and use of KM creation practices (path coefficient = 0.363, $p < 0.001$), KM transfer practices (path coefficient = 0.436, $p < 0.001$), KM storage practices (path coefficient =0.597, $p < 0.001$), and KM application practices (path coefficient =0.494, $p < 0.001$).

Finally, results also confirm the indirect effect of knowledge-oriented leadership on a company's innovation results through knowledge management initiatives (H7). The effect is strong (path coefficient = 0.318, $p < 0.001$) and accounts for 44.2% of the explained variance of innovation performance.

Table 2
Quality of structural equation.

	CV-communality	CV-redundancy
Innovation	0.61	0.32
KM creation	0.68	0.10
KM application	0.36	0.26
KM storage	0.20	0.18
KM transfer	0.53	0.39
K-O leadership	0.55	0.55

4. Discussion and conclusion

The volume of research on how best to design and implement organizational factors to yield further innovation is growing, owing to this question's theoretical importance and practical relevance for firms. Among these factors, leadership is a way of establishing a clear direction for employees to accomplish organizational tasks (Dessler, 2001). This article's thesis is that, in knowledge-based organizations, leadership should also contribute to creating the conditions for adequate management of knowledge through KM initiatives (Yahya & Goh, 2002). To gain competitive advantages based on innovation, knowledge creation, transfer, and application is necessary beforehand to develop new products that allow the firm to reach the competitive frontier (DeCarolis & Deeds, 1999). From this perspective, knowledge-oriented leadership behaves like a dynamic capability, with a focus on the continuous reconfiguration of a firm's knowledge position through initiatives to articulate, codify, and utilize both tacit and explicit knowledge (Wang & Ahmed, 2007; Zollo & Winter, 2002).

The first objective of this paper has been to analyze the extent to which a specific type of leadership behavior – knowledge-oriented leadership – is an essential element for technology firms to obtain further innovation. The results confirm that the existence of this kind of leadership – combining features of transformational and transactional leadership styles, along with elements of effective motivation and communication – is antecedent to the KM practices of creation, transfer, storage, and application. First, the results of the study show knowledge-oriented leadership's strong impact on KM creation practices. These initiatives mainly relate to experimentation through internal R&D and shifts in current technological trajectories (Gupta, Smith, & Shalley, 2006). In this regard, a strong knowledge-oriented leadership position forces the firm to embark on substantial investment and development initiatives to generate new knowledge. This kind of organizational leadership leads the firm's employees to believe that knowledge creation, via R&D support, is essential for organizational development and competitive advantage (Nonaka & Takeuchi, 2011).

Results also reveal that KM transfer, storage, and application practices have significant relations with knowledge-oriented leadership. Again, the mixture between transformational and transactional styles is an effective way of promoting KM practices to do with incremental change via the exploitation of existing knowledge (Oke, Munshi, & Walumbwa, 2009). Along these lines, Jansen et al. (2009: 9) point out that transformational leadership styles "provide the distant leadership that communicates to organizational members the need to refine current capabilities in existing domains and apply current knowledge." Transactional features of knowledge-oriented leadership such as rewards and monitoring of knowledge activities also contribute to the development of KM transfer, storage, and application practices. Hence, firms with a greater tendency toward a knowledge-oriented leadership

Table 3
Structural model: decomposition of effects.

Path	Standardized coefficients (t-values)		
	Total effects	Direct effects	Indirect effects
K-O leadership → KM transfer	0.71 (14.24***)	0.44 (5.74***)	0.28 (2.35*)
K-O leadership → KM storage	0.60 (9.67***)	0.60 (9.67***)	
K-O leadership → KM application	0.65 (10.05***)	0.49 (5.16***)	0.16 (1.97*)
K-O leadership → KM creation	0.36 (3.35***)	0.36 ((3.35***)	
KM storage → KM transfer	0.46 (5.83***)	0.46 (5.83***)	
KM storage → KM application	0.27 (2.27*)	0.27 (2.27*)	
KM creation → Innovation	0.54 (6.74***)	0.54 (6.74***)	
KM transfer → Innovation	−0.11 (1.12)	−0.11 (1.12)	
KM storage → Innovation	0.03 (0.73)		0.03 (0.73)
through KM transfer			−0.05 (0.92)
through KM application			0.08 (1.02)
KM application → Innovation	0.31 (2.87**)	0.31 (2.87**)	
K-O leadership → Innovation	0.32 (3.52***)		0.32 (3.52***)

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

position seem to consider efforts devoted to the development and support of knowledge exploitation practices for organizational functioning and performance worthwhile.

The second objective has been to analyze the effect of KM practices on innovation. As anticipated, KM creation and application practices share positive relationships with product innovation performance. Traditionally, research demonstrates that these KM activities have associations with innovation advantages in products (e.g., Chen & Huang, 2009; Donate & Guadamillas, 2011; López-Cabrales et al., 2009; Revilla, Prieto, & Rodríguez-Prado, 2010), as new or existing combined knowledge can contribute to either radical or incremental product innovation (Darroch & McNaughton, 2002). Nevertheless, the results of the current study show that only some KM practices have positive relationships with innovation performance. While the hypotheses posit an indirect relationship between KM storage and innovation, the results ultimately fail to offer evidence in support of this hypothesis. Although the correlations between KM storage and both KM transfer and KM application are significant, any mediating effect in the structural model is absent. Moreover, significant evidence of the relationship of KM transfer practices with innovation performance is also missing. Possible explanations hinge on the type of innovation results this study considers to measure this concept. Following this assumption, the effect of KM storage and transfer practices on innovation would have a higher impact on processes than products, since storage and dissemination do not strictly have to do with innovation, but rather gaining efficiency by recycling existing knowledge. Innovation is thus more likely to arise in the process of implementing these KM practices when routines and technologies improve as a consequence of non-deliberate learning, knowledge articulation, and codification (Gupta et al., 2006; Zollo & Winter, 2002).

The third objective of this study has been to contribute to the KM literature by showing that KM practices mediate the relationship between knowledge-oriented leadership and a firm's innovation performance. As the hypotheses propose, when a firm has a greater tendency toward a knowledge-oriented leadership position, this firm develops and supports a larger volume of KM initiatives, which, in turn, positively affect its innovation performance. This knowledge-oriented leadership integrates elements of disparate styles, such as transformational and transactional, along with motivation and communication elements, which appear to be necessary to develop and propel KM initiatives for further product innovation (Ribiere & Sitar, 2003). An important consequence and key managerial implication of this finding is that knowledge-based organizations should be
able to integrate practices oriented toward knowledge exploration (creation) and knowledge exploitation (storage, transfer, and application). Such organizations should also be able to flexibly shift the stress on these elements as per the demands of the situation (Miller et al., 2007). Hence, developing an environment that encourages the use of both exploration and exploitation practices – through knowledge-oriented leadership – is an essential condition for managers to improve a firm's innovation capacity. Even teams that are specialists in knowledge creation need some degree of support from reward and monitoring schemes, as they have to produce tangible results at some point and identify unresolved errors when they arise (Rosing et al., 2011). Moreover, teams that engage in knowledge exploitation may also need a knowledge vision of continuous improvement to boost commitments to innovation (Nonaka & Takeuchi, 2011). In any case, availability of and support for KM practices should exist for knowledge-oriented leadership to be effective regarding new product development.

An additional contribution of this paper is to delve into the theory on the relationships between leadership, KM practices and innovation performance through an extensive literature review, and anticipate a number of effects among these constructs. Moreover, this study addresses the call for additional research on how leadership can influence organizational level processes and performance such as innovation (e.g., Singh, 2008; von Krogh et al., 2012; Yukl, 1999).

Finally, the following aspects are some of this study's limitations. First, the research design of this study is cross-sectional, and, although results are consistent with theoretical reasoning, the research design is incapable of confirming the causal relationships set out in the hypotheses. Future research could address this issue by using a longitudinal design. Second, the study analyzes common knowledge-oriented leadership characteristics for KM creation, transfer, storage, and application practices. Nevertheless, approaches that are more specific may be necessary to take full advantage of each process so as to obtain distinct

results when firms find themselves in different contexts (e.g., environment and time stage) (Rosing et al., 2011). Hence, when a firm requires creativity and experimentation to confront scenarios of radical change, a transformational leadership style is probably most fitting, whereas, in more stable situations, transactional leadership may be more appropriate, as the firm essentially pursues efficiency (Wang & Ahmed, 2007). In this regard, future studies could try to analyze specific leadership styles in KM in different environmental or temporal settings. Third, this study uses self-report data, which may suffer from the effects of common method variance. Although the Harman test implies this phenomenon is negligible in the current study, the issue may still exist. Future research could benefit from independently obtaining and using objective measures of innovation. Fourth, this study applies the t-test to verify that non-response bias is an insignificant issue. The survey's low response rate is nevertheless still a potential limitation. To validate the

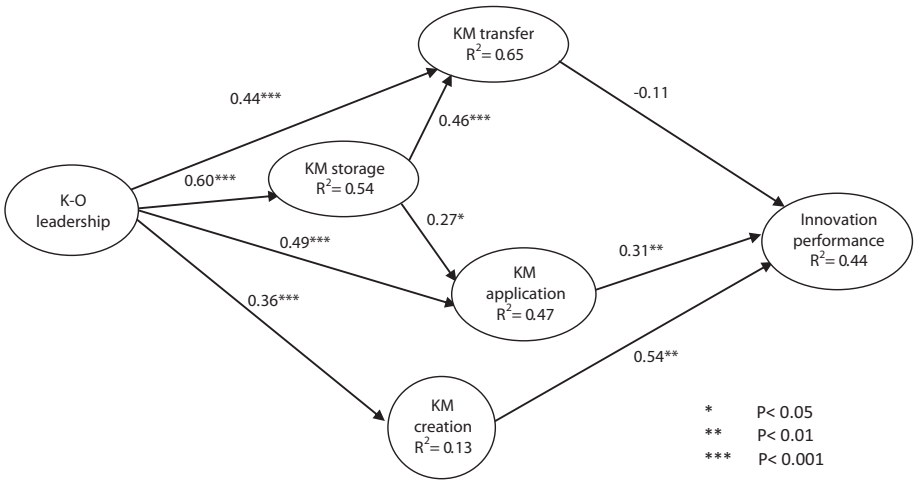

Fig. 2. Research model (standardized solution).

results of the study and increase the sample size, future research could focus on a wider range of technology industries. Fifth, the research centers on Spanish companies, so potential cultural limitations may exist. Future research could therefore target different cultural contexts – countries or geographical areas – in order to validate the results for a broader spectrum of cultures and geographies.

In conclusion, this paper shows the effect of knowledge-oriented leadership on KM practices for further innovation. The empirical evidence has important implications for managers, and marks progress in the research on the mediating effects of organizational factors in the relationship between KM and innovation.

Appendix A. (Questionnaire items)

A.1. KM creation practices

Over the last three years, in this company: (from 1–strongly disagree to 7–strongly agree):

- There is a strong commitment (for example, training, equipment) to depend on internal R&D activities to develop or improve technologies (products, processes) (KMc1).
- There is a strong investment on R&D activities to develop or improve technologies internally (products, processes) (KMc2).
- There is a strong commitment to use proprietary technology to develop or improve products/processes (KMc3).
- There is a strong commitment to maintain a highly qualified R&D unit to internally develop or improve technologies (products, processes) (KMc4).

A.2. KM storage practices

Over the last three years, in this company: (from 1–strongly disagree to 7–strongly agree):

- Organizational processes are codified and documented in manuals or other types of devices (KMs1).
- There are databases that allow employees to use knowledge and experiences that have previously been loaded into the databases (KMs2).
- There are phone or e-mail directories (referring to departments and sections) to find experts in specific areas (KMs3).
- It is possible to access knowledge repositories, databases and documents through some kind of internal computer network (for instance, an intranet) (KMs4).
- There are databases with updated information about customers (KMs5).
- Databases are frequently updated (KMs6).
- There are procedural guidelines, manuals, or books including problems that have been solved successfully (KMs7).

A.3. KM transfer practices

Over the last three years, in this company: (from 1–strongly disagree to 7–strongly agree):

- Information technologies (internet, intranet, e-mail, etc.) are used in order to encourage information flows and improve employees' communication (KMt1).
- The firm's objectives and goals are clearly communicated to all the organizational members (KMt2).
- There are frequent, well-distributed internal reports that inform employees about the firm's progress (KMt3).
- There are periodical meetings in which employees are informed about the new initiatives that have been implemented (KMt4).
- There are formal mechanisms that guarantee best practices to be shared in the firm (for instance, among departments or business areas) (KMt5).
- There are projects with interdisciplinary teams to share knowledge (KMt6).
- There are employees that compile suggestions from other employees, customers and suppliers, and produce structured reports to distribute throughout the company (KMt7).
- There are communities of practices or learning groups to share knowledge and experiences (KMt8).

A.4. KM application practices

Over the last three years, in this company: (from 1–strongly disagree to 7–strongly agree):

- All the employees have access to relevant information and key knowledge within the firm (KMa1).
- There are interdisciplinary teams with autonomy to apply and integrate knowledge (KMa2).
- Suggestions from employees, customers or suppliers are frequently incorporated into products, processes or services (KMa3).
- Knowledge that has been created is structured in independent modules, which allow for its integration or separation to create different applications and new usages (KMa4).
- It is quite common to use external experts with experience on a specific subject in order to solve particular problems (acting as advisers) (KMa5).

A.5. Knowledge-oriented leadership

Over the last three years, in the company (from 1–strongly disagree to 7–strongly agree):

- Leadership has been creating an environment for responsible employee behavior and teamwork (K-OL1).
- Managers are used to assuming the role of knowledge leaders, which is mainly characterized by openness, tolerance of mistakes, and mediation for the achievement of the firm's objectives (K-OL2).
- Managers promote learning from experience, tolerating mistakes up to a certain point (K-OL3).
- Managers behave as advisers, and controls are just an assessment of the accomplishment of objectives (K-OL4).
- Managers promote the acquisition of external knowledge (K-OL5).
- Managers reward employees who share and apply their knowledge (K-OL6).

A.6. (Product) innovation performance

Assessment of the level of innovation performance obtained in the last year for this company with regard to: (from 1–very low to 7–very high):

- Development of new products (Inn1).
- Modification and/or improvement of existing products (Inn2).
- Introduction of more new (or improved) products than major competitors (Inn3).
- Introduction of more new (or improved) products than the industry average (Inn4).
- Introduction of more new (or improved) products than three years ago (Inn5).

A.7. Level of R&D spending

Assessment of the R&D spending over the last three years for this company: (from 1–very low to 7–very high):

- Level of spending on R&D (R&D1).
- Level of spending on R&D in comparison to the main competitor (R&D2).
- Level of spending on R&D in comparison to the last three years (R&D3).
- Level of spending on R&D in comparison to the average spending in the industry (R&D4).

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