

# Knowledge management practices and innovation performance in Finland

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## Abstract

**Purpose** – Recent empirical studies have suggested that knowledge-based issues are closely related to companies' innovation performance. However, the majority of research seems to be focused either on static knowledge assets or knowledge processes such as knowledge creation. The purpose of this paper is to concentrate on the conscious and systematic managerial activities for dealing with knowledge in firms (i.e. knowledge management (KM) practices), which aim at innovation performance improvements through proactive management of knowledge assets. The study explores the impact that KM practices have on innovation performance.

**Design/methodology/approach** – The authors provide empirical evidence on how various KM practices influence innovation performance. The results are based on survey data collected in Finland during fall 2013. The authors use partial least squares to test the hypothesized relationships between KM practices and innovation performance.

**Findings** – The authors find that firms are capable of supporting innovation performance through strategic management of knowledge and competence, knowledge-based compensation practices, and information technology practices. The authors also point out that some of the studied KM practices are not directly associated with innovation performance.

**Originality/value** – This study adds to the knowledge-based view of the firm by demonstrating the significance of the management of knowledge for innovation performance. Furthermore, the division of KM practices into ten types and the provision of the validated scales for measuring these add to the general understanding of KM as a field of theory and practice. This study is valuable also from managerial perspective, as it sheds light on the potentially most effective KM practices to improve companies' innovation performance.

**Keywords** Innovation, Knowledge management practices, Performance, Knowledge management, Survey

**Paper type** Research paper



## Introduction

In recent decades, knowledge management (KM) has been one of the most influential and visible novel approaches to the art and science of management. Nowadays KM is a widely based discourse, promoted by academics, consultants, practitioners, and business press alike (e.g. Scarbrough *et al.*, 2005). Recent research has established that KM influences firm performance by providing organizations an effective framework to implement their innovation strategies (Ciabuschi and Martin, 2012;

Moustaghfir and Schiuma, 2013; Quintane *et al.*, 2011; Rasmussen and Nielsen, 2011). Thus, it seems that KM is an effective means for increasing the innovation performance of an organization (Andreeva and Kianto, 2011; Chen *et al.*, 2010; Lee *et al.*, 2013; Lin *et al.*, 2012).

A great deal of research has focused on issues such as the relationship of generic knowledge processes like knowledge acquisition, sharing, and creation (e.g. Chen *et al.*, 2010; Lee *et al.*, 2013) or knowledge-based assets like human, structural, and relational capital (e.g. Subramaniam and Youndt, 2005; Wang and Chen, 2013; Castro *et al.*, 2013; Menor *et al.*, 2007; Aramburu and Saenz, 2011) on innovation performance. However, few studies have examined the impact that the implementation of conscious and systematic managerial activities (i.e. KM practices) have on firm innovation performance. In fact, even though some previous studies have examined the association between KM practices and a firm's innovation performance, they have either considered only one or a few KM practices (e.g. Camelo-Ordaz *et al.*, 2011; Chen and Huang, 2009; Donate and Canales, 2012; Hurmelinna-Laukkanen, 2011; Sarin and McDermott, 2003; Soto-Acosta *et al.*, 2014; Yang *et al.*, 2009; Vanhala and Ritala, forthcoming) or firm performance outcome indicators aside from those related to innovation (e.g. Gold *et al.*, 2001; Lee and Choi, 2003; Atapattu and Jayakody, 2014). Furthermore, the Global KM Network, coordinated by Dr Peter Heisig, has conducted a ground-breaking study interviewing more than 200 KM experts world-wide. According to this international expert panel, the key research gap in the field is a better understanding of the relationship between KM and firm performance (Heisig, 2014; Perez-Arrau *et al.*, 2014). Therefore, a topical issue worthy of further study is the demonstration of how engaging in KM practices enhances firm performance in terms of direct financial benefits or indirectly through, e.g. increased innovation performance.

To bridge this gap in the existing knowledge, this paper addresses the question of how KM practices impact the innovation performance of companies. The goal of this research is to increase knowledge on the abilities of firms to increase their innovation performance through engaging in KM activities. By dividing intentional KM activities into ten types and exploring their impact on innovation, we add to the knowledge-based view of the firm and the literature on KM. In addition, we contribute to knowledge on innovation management by exploring novel sets of managerial methods to improve company innovativeness.

This paper is structured as follows: first, we theoretically explore KM practices by defining them and examining how they are likely to impact a firm's innovation performance. Then we empirically examine the relationship of ten types of KM practices and innovation performance. The data set contains information collected from a cross-industry sample by means of a structured survey involving 259 Finnish firms, each with at least 100 employees. We conclude by discussing our findings and their implications for managing knowledge in a beneficial manner and for the knowledge-based view of the firm.

### **KM practices**

Andreeva and Kianto (2012) defined KM practices as the set of management activities conducted in a firm with the aim of improving the effectiveness and efficiency of organizational knowledge resources. KM practices refer to the aspects of the organization that can be manipulated and controlled by conscious and intentional management activities (Andreeva and Kianto, 2012; Foss and Michailova, 2009). Accordingly, we conceptualize them as the set of management activities that enable the firm to deliver value from its knowledge-based assets.

The existing literature has typically discussed four major categories of critical success factors for KM: first, human-oriented, which includes culture, people, and leadership;

second, organization-oriented, which consists of processes and structures; third, technology-oriented, which relates to both infrastructure and applications; and fourth, management processes-oriented, which involves strategy, goals, and measurement (Heisig, 2009). In this study, we divide KM practices into ten main categories which can be tracked back to the quartet that Heisig mentioned. Our ten KM practices are related to supervisory work, knowledge protection, strategic management of knowledge and competence (strategic KM), learning mechanisms, information technology (IT) practices, work organization, and four dimensions of human resource management (HRM) practices – recruiting, training and development, performance appraisal, and compensation practices. We separated knowledge protection from other strategic activities because of the increased attention it has attracted during the discussion on open innovation (e.g., Chesbrough, 2003; Huizingh, 2011). In addition, we split the HRM practices into four categories in order to enable more fine-grained analysis.

Supervisory work is arguably the most crucial factor in developing organizational culture. The management-level has a direct impact on how the rest of the company deals with, e.g. key KM activities, as they act as natural example-setters for the others. It can be even argued that, if KM does not unfurl to all levels of the organization, with the management taking the highest responsibility, it is unlikely that it will ever catch on (DeTienne *et al.*, 2004). Leadership is a catalyst for inspiring, mentoring, setting examples, creating an atmosphere of trust and respect, installing a creative culture, establishing a vision, listening, learning, teaching, and sharing knowledge (Holsapple and Singh, 2001). Therefore, we regard supervisory work as a mean to establish an innovative culture within a company.

Building on the reasoning presented above, we formulate the following hypothesis:

*H1.* KM supportive supervisory work is positively associated with the firm's innovation performance.

Protecting the strategically significant knowledge of the firm from competitor imitation is a key issue for ensuring the appropriability of intangibles-based profits (Teece, 1998). Knowledge in general is a public asset, and the mere act of marketing it makes it available more widely. As a result, having conscious practices in place for protecting the key value-creating intangibles in the firm is highly important. Firms that utilize both informal and formal mechanisms of knowledge protection (Olander, 2011) are likely to be more successful in terms of both competitiveness and innovation performance (Hurmelinna-Laukkanen and Puumalainen, 2007).

Consequently, we formulate the following hypothesis:

*H2.* Knowledge protection practices are positively associated with the firm's innovation performance.

Strategic KM can be defined as the strategic planning, implementation, and updating activities related to the knowledge-based assets in the firm (Kianto *et al.*, 2014). It taps into identifying the key strategic knowledge within the organization and building a knowledge-based strategy, as well as activities for monitoring and measuring knowledge assets in the firm, and their developmental needs in relation to the business environment (Dalkir, 2005; Kianto, 2008; McKeen *et al.*, 2005; Skyrme and Amidon, 1997; Zack, 1999a). Strategic KM activities can increase organizational performance through the following mechanisms: first, they enable the organization to focus on the most value-creating activities of the firm, which is important as researchers have suggested that the intangible assets are the focal sources of

competitive advantage (Barney, 1991; Conner and Prahalad, 1996; Grant, 1996). Second, strategic KM also enables the organization to craft strategies based on the knowledge-based advantages they have over their competitors (Zack, 1999b). Furthermore, strategic KM practices enable the organization to make strategic decisions of allocation, utilization, expansion, and sharing of the company's knowledge base that follow the overall strategic aims of the company (as suggested by Zack, 1999b; see also Von Krogh *et al.*, 2001).

Given the above considerations, we formulate the following hypothesis:

*H3.* Strategic management of knowledge and competence is positively associated with the firm's innovation performance.

HRM practices play a significant role in KM (Hislop, 2003; Scarbrough, 2003; Wong, 2005). HRM is typically defined as the management of the organization's employees (Foot and Hook, 2008). Usually HRM functions include tasks such as recruiting, compensation, performance appraisal, and training and development. The ultimate goal of HRM is to find and select the best-fitting employees, and to use appropriate remuneration, training, and evaluation mechanisms to retain and bring out the best in them. KM-focused HRM practices can increase innovation performance through four main mechanisms. First, by paying attention to the candidates' knowledgeability and social skills in the recruitment process, the firms increase the availability of a knowledgeable workforce for producing effective and efficient performance in knowledge-intensive tasks (Chen and Huang, 2009; Currie and Kerrin, 2003; Scarbrough, 2003). Also, the likelihood of matching the person with the best expertise to the right task is increased by defining work roles and positions based on competences. Second, training and development is another HRM practice that greatly influences the firm's knowledge base. A firm that actively plans and arranges courses, seminars, and other training for their employees keeps its knowledge base updated and competitive. The HR management's task is to assess and analyse training needs and provide and evaluate training (Senge, 1994). Third, performance appraisal is a regular employee performance review and career development session between an employee and his/her superior(s). Traditionally employees are evaluated based on their economic performance, but a KM-based system highlights knowledge activities (i.e. knowledge sharing, creation, and utilization). The probability that employees will contribute to knowledge activities increases when they are valued as much or more than straightforward economic performance. Fourth, a compensation scheme based on knowledge activities (i.e. knowledge sharing, creation, and utilization) increases the likelihood that employees will engage in such activities. Moreover, through acknowledging expertise in career advancement, the knowledge activity-based compensation scheme increases employee motivation to utilize more of their knowledge in their work. Finally, HRM practices are related with retention of knowledgeable employees within the organization with remuneration, compensation, and other means of acknowledging them (intangible and tangible motivations).

In view of the above, we formulate the following hypotheses:

*H4.* Knowledge-based recruiting practices are positively associated with the firm's innovation performance.

*H5.* Knowledge-based training and development practices are positively associated with the firm's innovation performance.

H6. Knowledge-based performance appraisal practices are positively associated with the firm's innovation performance.

H7. Knowledge-based compensation practices are positively associated with the firm's innovation performance.

Learning mechanisms (i.e. the improvement and increase of organizational knowledge and competence) are a key facet of effective knowledge-based operation. In the organizational context, learning mostly takes place as workplace learning through learning-by-doing or practice-based learning (Gherardi, 2009; Lave, 2009) or through vicarious social learning, that is, learning from others by observing their behaviour and its consequences. Specifically, learning-related KM practices increase innovation performance by improving access to collegial tacit and explicit knowledge, thereby increasing the quality of performance. By legitimizing vicarious learning, firms can increase employees' motivation to share and create knowledge. Also, learning practices improve a firm's innovation performance by providing opportunities for mentoring and coaching in the organization; in addition, providing opportunities for learning-by-doing will help employees share, build, and develop knowledge for organizational benefit.

Based on this understanding, we formulate the following hypothesis:

H8. Learning mechanisms are positively associated with the firm's innovation performance.

Practices related with utilizing technologically mediated information systems are another important means for improving the leverage of knowledge in a firm (Alavi and Leidner, 2001; Davenport and Prusak, 1998). Several IT practices for KM influence innovation performance. First, the improved, increased, and quicker access to a vast amount of electronic information, including social networks (social media), has opened up possibilities to utilize new sources of information in improved decision-making. Second, IT has improved possibilities for knowledge codification, which Nonaka and Takeuchi (1995) defined as turning tacit knowledge into explicit knowledge. Third, IT has provided means for advanced knowledge storage, and thus built organizational memory further and enabled efficient re-use of knowledge. IT practices can also contribute greatly to systematic knowledge analysis, improve knowledge combination from various sources, allow for location-independent, seamless access to knowledge and information within the organization and beyond, and increase the means and channels for collaboration and interaction among the organization's experts (e.g. Kankanhalli *et al.*, 2003). Finally, IT can also enable more rapid application of knowledge through workflow automation (Alavi and Leidner, 2001).

Therefore, we formulate the following hypothesis:

H9. KM supportive IT practices are positively associated with the firm's innovation performance.

Practices for organizing work include the organizational design issues that facilitate the leverage of knowledge in an organization. These entail decisions made concerning the division of work and responsibilities as well as the coordination of work (Mintzberg, 1992). For example, the distribution of power and decision making rights to knowledge workers has been suggested to speed up organizational activities as well as to promote innovativeness in firms (Davenport and Prusak, 1998). Furthermore, the establishment and utilization of cross-functional teams may stimulate knowledge creation, whereas too hierarchical a structure slows knowledge flows (Nonaka and

Takeuchi, 1995). The legitimization of various types of communities of practice and interest is likely to create powerful forums of knowledge development (Brown and Duguid, 2001; Mohrman *et al.*, 2002) that are therefore likely to enforce innovation performance.

Based on this argumentation, we formulate the following hypothesis:

*H10.* KM supportive work organization is positively associated with the firm's innovation performance.

### **Impact of KM practices on innovation performance**

According to the pioneering studies on a knowledge-based view of the firm, performance differences between organizations accrue due to their different stocks of knowledge and their differing capabilities in using and developing knowledge (Grant, 1996; Kogut and Zander, 1992; Spender and Grant, 1996). This means that the more an organization is utilizing management practices aimed to support efficient and effective management of knowledge for organizational benefit, the more likely it is to achieve high-business performance.

Several empirical studies have examined the influence of different aspects of knowledge-based assets and KM on innovation performance. One stream of papers has revealed that generic knowledge processes – such as knowledge creation and sharing (Chen *et al.*, 2010), knowledge sharing, application, and storage (Lee *et al.*, 2013), and knowledge creation, documentation and storage, sharing, and acquisition (Andreeva and Kianto, 2011) – have positive impacts on a firm's innovation performance. Another avenue of research has focused more on the knowledge-based assets and how the possession of those assets is associated with firm innovativeness. For instance, Wang and Chen (2013) found that the institutionalized knowledge and codified experience (i.e. organizational capital) and the interaction-based knowledge among individuals and their networks (i.e. social capital) mediate the relationship between HRM practices and incremental innovative capability, whereas social capital acts as a mediator between HRM practices and radical innovative capability. Moreover, Castro *et al.* (2013) discovered that highly creative, skilled, and experienced employees (i.e. human capital) supplemented with well-structured networks of the company's clients (i.e. customer capital) are the key ingredients in achieving a high degree of innovation performance. Menor *et al.* (2007) continued on the same stream of thought by stating that employees' skill levels and the relative organizational learning capabilities (i.e. human capital), the codified knowledge embedded in the processes and information systems (i.e. structural capital), and the degree of internal and external integration with suppliers and customers (i.e. social capital) constitutes an important antecedent for product innovation. Other researchers have found organizational culture to be an important enabler of knowledge-related behaviour at work (e.g. De Long and Fahey, 2000; Alavi *et al.*, 2006; Travica, 2013).

In sum, researchers have provided substantial information on the relationship between knowledge processes and innovation performance, as well as on the influence of knowledge assets such as intellectual capital on innovation performance. What seems to be lacking is empirical evidence of the relationship between the conscious and systematic managerial activities, the KM practices, and a firm's innovation performance. Among the few such studies, Chen and Huang (2009), Camelo-Ordaz *et al.* (2011), Soto-Acosta *et al.* (2014), and Vanhala and Ritala (forthcoming) pointed out a positive association between HRM practices and the firm's innovation performance. Andreeva and Kianto (2012) studied the combined impact of HRM practices and information and communication



technology (ICT) practices on firm competitiveness outcomes including innovativeness. They noted a direct relationship between ICT and innovation performance, as well as a mediated link between HRM practices and innovation performance (Andreeva and Kianto, 2012). Further, empirical literature has provided evidence that innovation performance can be facilitated by means of IT support (Yang *et al.*, 2009), knowledge strategy (Donate and Canales, 2012), knowledge protection (Hurmelinna-Laukkanen, 2011), and leadership behaviour (Sarin and McDermott, 2003). However, these examples are quite a rarity among the body of literature.

Based on the argumentation above, we posit that KM practices increase effective and efficient performance of knowledge-intensive tasks, and thereby the innovation performance of a firm. Specifically, this hypothesis can be broken into the smaller parts previously described, each representing a particular set of KM practices. More formally, we claim that the more intensively an organization applies a given KM practice, the higher innovation performance it is likely to attain.

## Methods

### *Sample and data collection*

We tested the hypotheses with survey data that was collected in Finland in 2013 by means of a structured survey, using the key-informant technique. The initial population comprised a cross-industry sample of Finnish companies that included only firms with at least 100 employees. We used the Intellia database to identify the companies. A total of 1,523 companies were considered suitable for the initial sample. An external research company contacted all the eligible firms by telephone to ask the person in charge of human resources to respond to the questionnaire. The company emphasized confidentiality and promised to provide a summary of the results to the respondents. Out of the 1,523 companies, we received 259 responses, representing a response rate of 17.0 per cent. The most represented industries were manufacturing (37.8 per cent) and wholesale and retail trade (16.2 per cent). Other notable industries were services (9.7 per cent) and transportation and storage (8.1 per cent). Based on statistical comparison (the  $\chi^2$  test) with the whole population of Finnish companies, we determined that manufacturing is over-represented and services is underrepresented in our sample, as these industries form 29.8 and 13.5 per cent of the entire population of the Finnish companies, respectively. In terms of number of employees, the largest group (39.8 per cent) employed 100-200 employees. One-fifth (20.0 per cent) of the companies employed 250-500 employees, 9 per cent employed 500-1,000 employees, and 8 per cent employed over 1,000 employees. Most of the respondents held position such as a HR director or manager (77.9 per cent), other director or manager (8.8 per cent), or managing director (6.9 per cent), indicating their expertise and key position regarding the issues of KM and innovation performance.

### *Measures*

*Independent variables.* We measured KM practices using primarily scales that we developed. Specifically, we created the supervisory work scale, the training and development scale, and the work organization scale. We created the learning mechanisms scale based upon inspiration from Becerra-Fernandez and Sabherwal (2001). We drew additional inspiration from the literature for the following scales: the strategic KM scale (inspired by McKeen *et al.*, 2005; Kianto *et al.*, 2014; Boumarafi and Jabnoun, 2008), the recruitment scale (inspired by Yanga and Linb, 2009;

Cabello-Medina *et al.*, 2011), the performance appraisal scale (inspired by Andreeva and Kianto, 2012), the compensation scale (inspired by Andreeva and Kianto, 2012), and the IT practices scale (inspired by Handzic, 2011; Negash, 2004; Pirttimäki, 2007). We adopted the remaining scale, the knowledge protection scale, from Levin *et al.* (1987), Cohen *et al.* (2000), Hurmelinna-Laukkanen and Puumalainen (2007), Hurmelinna-Laukkanen and Ritala (2012), and Lawson *et al.* (2012). All of the measures were based on five-point Likert scales (1 – strongly disagree, 5 – strongly agree).

*Dependent variables.* The innovation performance scale relied on work by Weerawardena (2003). The scale (Likert scale from 1 – very poorly to 5 – very well) consisted of five items wherein respondents were requested to compare their company's success to the competitors' in terms of creating innovations and new operating methods.

*Control variables.* We used three variables (i.e. firm age, the number of employees, industry) as control variables to eliminate whatever effects they might have had on innovation performance. We measured firm age in terms of years gone since establishment, and we utilized the number of employees as a proxy value for the firm size. For the industry variable, we used an adapted classification of eight classes based on the European statistical classification of economic activities.

### *Statistical methods*

We analysed the data collected with the structured survey method in several steps and using various statistical methods. First, we used correlation analysis in order to identify any interconnectedness between our independent and dependent variables. This was assessed by statistical significance as well as strength of the correlation.

Second, we conducted internal consistency analyses in order to test whether our measures were applicable to measure the constructs we were interested in. We evaluated internal consistency by two measures: construct reliability (CR) (based on the value of CR) and convergent validity. Convergent validity was assessed by value of CR, the strength, and statistical significance of the factor loadings, as well as with the value for the average variance extracted (AVE).

Third, we tested discriminant validity of the constructs in our study. Discriminant validity indicates whether the constructs actually differ from each other. We assessed discriminant validity by comparing the AVE by the individual constructs and the shared variance between a given construct and the other constructs in the model. The shared variance was calculated as squared correlation between two constructs; that is, we calculated it by squaring the correlations between each pair of constructs.

Finally, we used structural equation modelling for statistical testing of the hypothesized relationships. We utilized partial least squares (PLS) software for the analyses. We focused on the signs of the path estimates, the statistical significance and strength of the path estimates, and the amount of variance our independent variables (i.e. KM practices) were able to explain out of the dependent variable (i.e. innovation performance). We estimated a one direct effect model including all of our independent variables, three control variables (i.e. firm age, the number of employees, industry), and the dependent variable.

## **Results**

We drafted a model that was built on sound theoretical premises in order to test the hypothesized relationships between the KM practices and innovation performance.



We utilized PLS software for the analyses. The first steps were to assess the reliability and validity of the measurement model. After that, we used the structural model to test our hypotheses.

#### *Correlation analysis*

Table I presents the mean values, standard deviations, and correlation matrixes for the KM practices and innovation performance.

The matrix shows significant correlations throughout between the independent variables (i.e. KM practices) and the dependent variable (i.e. innovation performance). These findings indicate and support our expectations of interconnectedness between the KM practices and innovation performance.

#### *Measurement models*

In order to test the measurement models, we assessed the internal consistency as well as the discriminant validity.

Measures of CR and convergent validity represent internal consistency. The results of the CR test showcase that all the constructs had a value above the generally accepted threshold of 0.7 (Bagozzi and Yi, 1991) (see Appendix). In the test for convergent validity, we examined CR, the factor loadings, and AVE. First, all the items had high and statistically significant loadings throughout (see Appendix). This result tells us that all the items related to their specific constructs, verifying the posited relationships among the indicators and constructs. Second, the AVE measures exceeded the cut-off point of 0.50 (see, e.g. Fornell and Larcker, 1981) in all of our constructs. Thus, taking into account all the criteria for convergent validity, our measures seem to be applicable.

The test for discriminant validity indicates the extent to which the constructs differ from each other. In order to show discriminant validity, the AVE of the construct should be greater than the variance shared between that construct and the other constructs in the model (i.e. the squared correlation between two constructs) (Fornell and Larcker, 1981). All the constructs in our study met this condition; specifically, the diagonal elements (AVEs) were greater than the off-diagonal elements in the corresponding rows and columns (see Table II).

In sum, the model assessments gave good evidence of validity and reliability for the operationalization of the concepts.

#### *Testing the research models*

Our direct effect model for KM practices is able to explain 15 per cent of the variance in the innovation performance (see Table III).

The empirical evidence is mixed. On one hand, the results obtained suggest that the path estimates from strategic KM ( $B = 0.20, p < 0.05$ ), knowledge-based compensation ( $B = 0.21, p < 0.05$ ), and IT practices ( $B = 0.20, p < 0.05$ ) were as hypothesized. Thus, our  $H3, H7$ , and  $H9$  were supported. On the other hand, the path estimates from knowledge-based recruiting ( $B = -0.13, p < 0.05$ ) and learning mechanisms ( $B = -0.11, p < 0.1$ ) were contrary to  $H4$  and  $H8$ . The remainder of the posited relationships were statistically insignificant, and thus rejected  $H1, H2, H5, H6$ , and  $H10$  (see Table III).

Second, the path estimates from the control variables to the firms' innovation performance were insignificant. Thus, it seems that the conditions such as the firm size measured in the number of employees, the firm's age, and the industry do not influence the firms' ability to innovate.

Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10
1. Innovation performance	3.29	0.52										
2. Supervisory work	3.46	0.59	0.315**									
3. Knowledge protection	3.96	0.80	0.174*	0.323**								
4. Strategic KM	3.40	0.74	0.351**	0.490**	0.325**							
5. Knowledge-based recruiting	4.18	0.55	0.189**	0.456**	0.393**	0.374**						
6. Knowledge-based training and development	3.93	0.74	0.267**	0.532**	0.311**	0.449**	0.533**					
7. Knowledge-based performance appraisal	2.99	0.81	0.171*	0.519**	0.272**	0.536**	0.489**	0.519**				
8. Knowledge-based compensation	2.73	0.96	0.271**	0.401**	0.270**	0.489**	0.437**	0.386**	0.521**			
9. Learning mechanisms	3.39	0.78	0.182**	0.495**	0.183**	0.432**	0.435**	0.503**	0.598**	0.454**		
10. IT practices	3.57	0.59	0.302**	0.421**	0.489**	0.444**	0.408**	0.407**	0.369**	0.369**	0.399**	
11. Work organization	3.78	0.55	0.273**	0.574**	0.358**	0.374**	0.480**	0.651**	0.394**	0.363**	0.417**	0.506**

Note: \*\*, \*Correlation is significant at the 0.05 and 0.01 level (two-tailed), respectively

Table I. Correlation matrix for the research model

**Table II.**  
Discriminant validity

Variable	1	2	3	4	5	6	7	8	9	10	11
1. Innovation performance	0.67										
2. Supervisory work	0.10	0.55									
3. Knowledge protection	0.03	0.10	0.62								
4. Strategic KM	0.12	0.24	0.11	0.59							
5. Knowledge-based recruiting	0.04	0.21	0.15	0.14	0.65						
6. Knowledge-based training and development	0.07	0.28	0.10	0.20	0.28	0.58					
7. Knowledge-based performance appraisal	0.03	0.27	0.07	0.29	0.24	0.27	0.71				
8. Knowledge-based compensation	0.07	0.16	0.07	0.24	0.19	0.15	0.27	0.79			
9. Learning mechanisms	0.03	0.25	0.03	0.19	0.19	0.25	0.36	0.21	0.69		
10. IT practices	0.09	0.18	0.24	0.20	0.17	0.17	0.14	0.14	0.16	0.56	
11. Work organization	0.07	0.23	0.13	0.14	0.23	0.42	0.16	0.13	0.17	0.26	0.50

**Notes:** AVE associated with the construct is presented diagonally; the squared correlations between the constructs are presented in the lower left triangle

Path	Path coefficient(B)	t-Value
<i>Independent variables</i>		
Supervisory work→innovation performance	-0.01 ns	0.10
Knowledge protection→innovation performance	-0.04 ns	0.58
Strategic KM→innovation performance	0.20*	2.10
Knowledge-based recruiting→innovation performance	-0.13*	1.93
Knowledge-based training and development→innovation performance	-0.08 ns	1.08
Knowledge-based performance appraisal→innovation performance	-0.01 ns	0.17
Knowledge-based compensation→innovation performance	0.21*	2.11
Learning mechanisms→innovation performance	-0.11**	1.31
IT practices→innovation performance	0.20*	2.23
Work organization→innovation performance	0.07 ns	0.71
<i>Control variables</i>		
Employees→innovation performance	-0.02 ns	0.40
Firm age→innovation performance	0.03 ns	0.83
Industry→innovation performance	0.05 ns	1.10
R <sup>2</sup>		0.15

Notes: \*\*, \*Significant at < 0.10 and < 0.05, respectively

**Table III.**  
Testing the research models for KM practices and innovation performance

## Discussion

Overall, this study contributes to a better understanding of how knowledge should be managed for organizational benefit.

### *Strategic management of knowledge and competence*

According to our results, strategic KM was positively associated with the firm's innovation performance. The findings of the structural model suggested that innovation performance tends to be higher in the firms that consider knowledge and competences as the key factors in their strategy and strategic planning, and that update the strategy regularly and disseminate it thoroughly within the entire organization. Consequently, this study supports the argument that Donate and Canales (2012) made about the superiority of a proactive knowledge strategy in terms of maintaining a broad understanding of knowledge as a strategy, setting objectives, utilizing KM-specific tools, and recognizing the importance of KM culture and other tools for product and process innovation performance. In addition, this study partially confirms Theriou *et al.*'s (2011) finding about the crucial role of leadership for the sake of KM effectiveness and firm performance. Our results also add to the knowledge-based view of the company (e.g. Barney, 1991; Grant, 1996; Conner and Prahalad, 1996) by demonstrating that the knowledge resources possess strategic value in relation with the firm's innovation performance.

### *Knowledge-based compensation*

Another KM practice that is likely to be an influential contributor for firm's innovation performance is knowledge-based compensation. This HRM practice encourages employees to engage in knowledge-intensive activities through rewarding and promotion systems that recognize involvement in knowledge processes such as knowledge sharing, knowledge creation, and knowledge utilization. This finding reaffirms the prevailing understanding of how HRM practices could positively influence the firm's innovation performance by increasing the knowledge

processes (Chen and Huang, 2009), by adding to the employees' affective commitment (Camelo-Ordaz *et al.*, 2011), by increasing knowledge sharing (Soto-Acosta *et al.*, 2014), and by supporting impersonal trust (Vanhala and Ritala, forthcoming).

*KM supportive IT practices*

Furthermore, KM supportive IT practices could be an influential factor in a firm's innovation performance. This finding is in line with Yang *et al.* (2009), who determined that IT support for collaboration, communication, information search, real-time learning, simulation, and prediction was highly beneficial for a firm's innovativeness. Likewise, it aligns with findings by Andreeva and Kianto (2012), who wrote that ICT practices directly support firm performance, including innovation performance, and also mediate the effect of HRM practices. Further, Alavi and Leidner (2001) once stated that IT gives a big helping hand for a modern knowledge worker when it is utilized in information search and discovery, and in establishing new and efficient communication channels between a firm's internal and external stakeholders. IT can be also used to establish a new sort of capacity, such that a man cannot handle, as well as to collect and analyse business critical information from countless sources in order to assist in better decision-making (Cody *et al.*, 2002) (Table IV).

*Knowledge-based recruiting*

Contrary to our hypotheses, knowledge-based recruiting had a statistically significant negative association with the firm's innovation performance. Even though this finding comes as a surprise and is against the established empirical evidence (e.g. Chen and Huang, 2009; Camelo-Ordaz *et al.*, 2011), it is explainable. First, recruiting is a cornerstone for any functioning modern firm because new talent must be brought in as a replenishment due to the eventual retirement of senior staff members and other reasons such as lay-offs. Further, a well-conducted recruiting process improves the

Hypotheses

H1: KM supportive supervisory work is positively associated with the firm's innovation performance	Not supported
H2: knowledge protection practices are positively associated with the firm's innovation performance	Not supported
H3: strategic management of knowledge and competence is positively associated with the firm's innovation performance	Supported
H4: knowledge-based recruiting practices are positively associated with the firm's innovation performance	Not supported
H5: knowledge-based training and development practices are positively associated with the firm's innovation performance	Not supported
H6: knowledge-based performance appraisal practices are positively associated with the firm's innovation performance	Not supported
H7: knowledge-based compensation practices are positively associated with the firm's innovation performance	Supported
H8: learning mechanisms are positively associated with the firm's innovation performance	Not supported
H9: KM supportive IT practices are positively associated with the firm's innovation performance	Supported
H10: KM supportive work organization is positively associated with the firm's innovation performance	Not supported

**Table IV.**  
A summary  
of the findings

chance that a firm catches the right people to fill in the right positions. However, the labour market nowadays is vast and equally open practically for all the companies within the European Union, so there are good resources available for all the companies in an increasing fashion. Thus, firms are experiencing a diminishing chance to gain a competitive edge over their rivals by investing heavily in acquiring the key talent directly from the labour market. Instead, more decisive factors could be other KM practices which aim at increasing and extracting the value of the acquired human capital in the long run. Such practices could be a re-configured compensation plan, training and development programmes, and appropriate information systems.

### *Learning mechanisms*

Also, the learning mechanisms were negatively associated with the firm's innovation performance, although the result was only a statistically marginal one. Learning mechanisms in our study consist of knowledge transfer from senior staff members to more inexperienced ones through mentoring programmes, apprenticeships, and job orientation, as well as the organized collection and utilization of the best practices. Therefore, it seems that too heavy a reliance on lessons learned from past experiences or the dissemination of already existing knowledge may even turn against the firm's innovation performance, making outdated knowledge an innovation-hindering core rigidity for the firm (Leonard-Barton, 1995). One explanation for this phenomenon is that knowledge gets rapidly outdated in today's heavily turbulent business environment, and utilization of such knowledge in, for instance, research and development may lead to end products that do not generate the desired level of sales.

### *Other KM practices*

An additional five KM practices in our research model did not showcase statistically significant associations with the firm's innovation performance. This result could be partially explained by the theoretical contribution by Kianto *et al.* (2014), who suggested that improvements in firm performance outcomes could accrue from the combined effect of knowledge assets (i.e. intellectual capital) and systematic and deliberate managerial activities (i.e. KM practices). Thus, there are underlying potential interaction effects in terms of moderation and mediation, which cannot be detected by solely focusing on KM practices and firm performance outcomes. In order to increase understanding about the knowledge assets and innovation performance, the research path rising from these arguments should be a subject of future research.

### **Conclusion**

Overall, this study adds to a better understanding of how knowledge should be managed for organizational benefit. It contributes to the knowledge-based view of the firm by utilizing empirical data with a large sample size in order to demonstrate the most efficient management mechanisms for increasing innovation. Furthermore, the division of KM practices to ten types and the provision of the validated measurement scales adds to the general understanding of KM as a field of theory and practice, and offers avenues for further research with the same instruments. The research also adds to innovation management literature by demonstrating the impact of KM as a managerial tool for advancing innovation.

The results of this study increase understanding of the potentially most effective KM practices that are likely to improve a firm's innovation performance, and therefore



serve as a guideline for the managers. Our findings are especially valuable for managers, as we examined the influence of actual managerial practices on innovation performance. Thus, this study relates to the managers' daily work and could spark interest and actions among them.

Strategic planning, implementation, and updating activities which consider knowledge as the main component seem to be positively linked with company's innovativeness. In the practical level, strategic KM is about assessing current knowledge and the need for future knowledge. Then, KM strategy is formulated to bridge the gap between what there already is and what there should be. Equally important practice is to communicate and disseminate the strategy throughout the organization, in order to ensure that everyone is working for the common goal. Consequently, strategic KM supports innovation performance because it helps to identify a strategic knowledge gap which emphasizes the need for knowledge creation and new inbound knowledge flows.

Employees are typically being compensated based on their economic performance. For instance, salespersons receive bonuses for achieving or surpassing the set sales quotas, and project managers are compensated for steering projects to meet their goals in terms of time and budget. The findings of this study, however, indicate that firms are potentially better off, innovation performance-wise, if they base the incentive/compensation system on knowledge activities. When the traditional economic figures are replaced with indicators such as knowledge creation, sharing, and utilization, the employees will more probably engage with those activities and therefore improve the entire company's innovation performance.

ICT can be also utilized to make a difference in innovation performance. Nowadays, the amount of available information for companies is enormous. It could be seen as either a threat or an opportunity. The companies that see the positive side of the situation take advantage of IT support in searching, gathering, and analyzing the information in order to support their decision making and innovation performance. IT can also assist in open innovation by providing platforms to joint innovation with external parties, as well as establishing various communication channels for the internal and external stakeholders. Thus, managers should consider IT as not only a support system, but also as a means to achieve improved innovativeness and firm performance.

This study has some limitations due to the chosen research design and context, which also serve as a basis for further research directions. First, our study examined the relationship of KM practices and innovation in a country that belongs to the group of economically highly developed countries, accompanied with well-educated inhabitants; therefore, the results may not be generalizable to other national contexts. In future studies, this phenomenon should be examined also in other contexts. Second, single respondents were used to assess all the variables examined in the study. Further studies could improve on this limitation by utilizing more objective measures of innovation performance. This is also concern in terms of possible common method bias. Although it is not a major problem in this study, we suggest that future studies should involve different respondents with different organizational roles for independent and dependent to improve methodological rigour. Third, knowledge-intensity and innovation management vary greatly between industries. Thus, a comparative study about KM practices and innovation performance between different industries could be interesting to carry out. The findings from such a study could prove to be highly influential in industry-specific decision-making. Fourth, the current study is a correlational one-time study, conducted in a cross-sectional research setting. However, in order to examine the

causal relationships between the independent and dependent variables, a longitudinal study should be carried out. Collecting time-series data would allow researchers to gain a greater understanding of the causal and longitudinal nature of the effect of KM practices on innovation performance.

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Appendix

Table A1.  
Measurement items

Concept	Item	Factor loading	AVE	CR
Innovation performance	<i>Compared to its competitors, how successfully has your company managed to create innovations/new operating methods in the following areas over the past year? (1 = very poorly, 5 = very well)</i>			
	Products and services for customers	0.822***		
	Production methods and processes	0.762***		
	Management practices	0.844***	0.67	0.91
	Marketing practices	0.796***		
Supervisory work	Business models	0.851***		
	<i>To what extent do the following statements on supervisory work apply to your company? (1 = completely disagree, 5 = completely agree)</i>			
	Supervisors encourage employees to share knowledge at the workplace	0.818***		
	Supervisors encourage employees to question existing knowledge	0.699***		
	Supervisors allow employees to make mistakes, and they see mistakes as learning opportunities	0.656***	0.55	0.90
	Supervisors value employees' ideas and viewpoints and take them into account	0.828***		
	Supervisors promote equal discussion in the workplace	0.642***		
	Supervisors share knowledge in an open and equal manner	0.764***		
	Supervisors continuously update their own knowledge	0.765***		
	<i>To what extent do the following statements on knowledge protection apply to your company? (1 = completely disagree, 5 = completely agree)</i>			
Knowledge protection	Protecting strategic knowledge from those stakeholders to whom it is not intended	0.562***		
	Utilization of patents, agreements, legislation and other formal means	0.870***	0.62	0.82
Strategic management of knowledge and competence	Utilization of confidentiality, employee guidance and other informal means	0.880***		
	<i>To what extent do the following statements on strategic knowledge and competence management apply to your company? (1 = completely disagree, 5 = completely agree)</i>			
	Strategy is formulated and updated based on company knowledge and competences	0.777***		
	Strategy addresses the development of knowledge and competences	0.774***	0.59	0.85
	Strategic knowledge and competence is systematically benchmarked against the competitors	0.770***		
	The responsibility for strategic knowledge management has been clearly assigned to a specific person	0.755***		

(continued)

Concept	Item	Factor loading	AVE	CR
Knowledge-based recruiting	<i>To what extent do the following statements on human resources management apply to your company?</i> (1 = completely disagree, 5 = completely agree)			
	Special attention to relevant expertise	0.786***		
	Special attention to learning and development ability	0.806***	0.65	0.85
	The candidates' ability to collaborate and work in various networks is evaluated	0.831***		
	<i>To what extent do the following statements on human resources management apply to your company?</i> (1 = completely disagree, 5 = completely agree)			
Knowledge-based training and development	Employees are provided with opportunities to deepen and expand their expertise	0.715***		
	The company offers training that provides employees with up-to-date knowledge	0.525***	0.58	0.84
	The employees have an opportunity to develop their competence through training tailored to their specific needs	0.922***		
	The employees' development needs are discussed with them regularly	0.815***		
	<i>To what extent do the following statements on human resources management apply to your company?</i> (1 = completely disagree, 5 = completely agree)			
Knowledge-based performance appraisal	The sharing of knowledge is one of our criteria for work performance assessment	0.739***		
	The creation of new knowledge is one of our criteria for work performance assessment	0.837***	0.71	0.88
	The ability to apply knowledge acquired from others is one of our criteria for work performance assessment	0.934***		
	<i>To what extent do the following statements on human resources management apply to your company?</i> (1 = completely disagree, 5 = completely agree)			
	The company rewards employees for sharing knowledge	0.870***		
Knowledge-based compensation	The company rewards employees for creating new knowledge	0.885***	0.79	0.92
	The company rewards employees for applying knowledge	0.917***		
	<i>To what extent do the following statements on learning practices apply to your company?</i> (1 = completely disagree, 5 = completely agree)			
	Knowledge is transferred from experienced to inexperienced employees through mentoring, apprenticeship, and job orientation, for example	0.510***		
	The company systematically collects best practices and lessons learned	0.969***	0.69	0.86
Learning mechanisms	The company makes systematic use of best practices and lessons learned	0.938***		

(continued)

Table AI.

Table A1.

Concept	Item	Factor loading	AVE	CR
IT practices	<i>To what extent do the following statements on IT management practices apply to your company? (1 = completely disagree, 5 = completely agree)</i>			
	Technology is utilized to enable efficient information search and discovery	0.776***		
	Technology is utilized to enable internal communication throughout the organization	0.616***		
	Technology is utilized to communicate with external stakeholders	0.767***	0.56	0.88
	Technology is utilized to analyse knowledge in order to make better decisions	0.763***		
Work organization	Technology is utilized to collect business knowledge related to its competitors, customers, and operating environment, for example	0.792***		
	Technology is utilized to develop new products and services with external stakeholders	0.770***		
	<i>To what extent do the following statements on work organizing apply to your company? (1 = completely disagree, 5 = completely agree)</i>			
	Employees have an opportunity to participate in decision making in the company	0.673***		
	Work duties are defined in a manner that allows for independent decision-making	0.507***	0.50	0.85
Note: ***Significant at < 0.005	Informal interaction is enabled between members of our organization	0.793***		
	Face-to-face meetings are organized when necessary. When necessary, working groups with members who possess skills and expertise in a variety of fields	0.653***		
	Working groups with members who possess skills and expertise in a variety of fields	0.720***		
	When needed, our company makes use of various expert communities	0.828***		

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### About the authors

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