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Advancing a knowledge-based dynamic capabilities framework to predict innovation

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Abstract

This study extends the model of Lichtenthaler and Lichtenthaler (2009), presuming that a firm can develop absorptive capacity and transformative capacity (i.e. its realized knowledge capacities) by actively implementing external knowledge acquisition and internal knowledge sharing practices (i.e. its potential knowledge capacities). These knowledge capacities form part of the firm's knowledge-based dynamic capabilities, which enhance the firm's innovation orientation and performance in turn. We test hypotheses on a sample of 649 Dutch SMEs. Results clearly support that practices aimed at acquiring external knowledge foster a firm's innovation performance, mediated by innovation orientation. This study contributes to the management literatures of knowledge management and strategy by advancing a knowledge-based dynamic capabilities framework to predict innovation. The proposed framework creates a link between individual action and firm-level routines or capabilities by focusing on KM practices as recurring patterns of individual behaviors. The framework and results also support a combined emergent-deliberate view of innovation strategy.

INTRODUCTION

Small and new firms are surprisingly innovative. Research over the past thirty years repeatedly shows patterns that a disproportionate amount of innovation (including new patents and other inventions and discoveries) comes from small and medium sized firms (SMEs) (Acs, 1996; Thompson and Leyden, 1983). However, empirical research that explains how SMEs foster innovation within their firms is far more limited. This is a primary focus of the present study. More specifically, we test empirically for links between certain knowledge management (KM) practices and innovation within the context of a knowledge-based dynamic capabilities framework (Lichtenthaler and Lichtenthaler, 2009).

KM practices are those organizational routines by which a firm acquires, shares, transfers and/or exploits knowledge. In the SME context, we focus on two aspects of KM practices: *external knowledge acquisition* and *internal knowledge sharing*. KM practices, in turn, contribute to a firm's abilities to renew and develop its capabilities of managing different knowledge processes, which we call a firm's *knowledge capacities* (Lichtenthaler and Lichtenthaler, 2009). We adopt the terms *absorptive capacity* and *transformative capacity* to refer to the knowledge capacities resulting from external knowledge acquisition and internal knowledge sharing respectively. Absorptive capacity and transformative capacity are two of several possible capacities which contribute to the overall ability of the firm to manage its knowledge (Lichtenthaler and Lichtenthaler, 2009).

Innovation performance is defined as the extent to which a firm develops and/or introduces new products or services. In addition, we also introduce a term called *innovation orientation* in the framework, which refers to a firm's intention to develop new products, services or processes to

renew or to improve existing products, services or processes (Homburg et al., 2002; Kundu and Katz, 2003; Worren et al., 2002).

The research areas of knowledge, knowledge management and organizational learning have become increasingly linked to one another and to the dynamic capabilities perspective. The dynamic capabilities perspective emphasizes that a firm's abilities to renew and to develop its organizational capabilities are essential for building and sustaining competitive advantage (Eisenhardt and Martin, 2000; Grant, 1996; Kogut and Zander, 1993; Nonaka and Takeuchi, 1995; Spender, 1996; Teece et al., 1997). In the proposed framework, the abilities to acquire, assimilate and apply knowledge, which we collectively refer to as knowledge capacities, represent a particular subset of dynamic capabilities which has taken on growing interest in the management literature (Lane et al., 2006; Lichtenthaler, 2009; Lichtenthaler and Lichtenthaler, 2009; Zahra and George, 2002).

The assertion that knowledge capacities can affect firm-level outcomes, including innovation, is not new. However, the majority of this research focuses on large firms and on firm-level concepts (Eisenhardt and Martin, 2000; Kogut and Zander, 1992; Nelson and Winter, 1982; Teece et al., 1997; Winter, 2003). However, even in large firms, an understanding of why or how such capacities are linked with performance is still not clear. As pointed out by Cartwright (1989), firms do not act, people do. In this view, firms do not actually possess dispositions to act. Rather, firm-level routines can be viewed as recurring patterns of individual behaviors. Such patterns not only represent aggregations of individual acts however. Over time, they can be viewed as descriptive norms which establish guidelines for future behaviors (Aarts and Dijksterhuis, 2003; Nolan et al., 2008; Smith and Louis, 2008). Thus, there is a clear link between the individual and firm-level phenomena, grounded in individual concrete activities. Note that in this study we do not measure

individual behaviors (also called micro-foundations by Abell et al (2008)) directly. However, we do attempt to examine in relatively concrete terms how SMEs actually foster innovation within their firms using various KM practices. We also examine the role of innovation orientation as emergent strategy, resulting from such routines, and, in turn, as a deliberate strategy influencing subsequent innovation performance.

To summarize, the present paper contributes to the existing literature in several ways. *First*, building upon the model of Lichtenthaler and Lichtenthaler (2009), we present a knowledge-based dynamic capabilities model which treats KM practices as aspects of potential (vs. realized) knowledge capacities. *Second*, we expand on the empirical literature by providing insight into which KM practices contribute positively to innovation orientation and performance within SMEs (Desouza and Awazu, 2006; Sparrow, 2001; Wong and Radcliffe, 2000). *Third*, by focusing on KM practices as recurring patterns of behaviors or routines, we create a link between individual action (i.e. micro-foundations) and firm-level routines or capabilities, showing further, how organizational routines or practices may stimulate innovation. *Fourth*, our findings support a view of strategy in SMEs which shows that innovation orientation can be viewed from both an emergent and deliberate strategic perspective (Mintzberg et al., 1998). *Finally*, in the discussion section we link our findings to future directions in research which can further enhance our understanding of the micro-foundations of dynamic capabilities (Abell et al., 2008).

The remainder of this paper is organized as follows: first, we present and explain key concepts used in our framework including KM practices, knowledge capacities, innovation orientation and innovation performance. Second, we present the conceptual framework, hypotheses and rationale. Third, we discuss the research methodology regarding sampling, measures and model

tests. The remaining sections cover the results, discussion, practical implications and directions for future research, as well as conclusions.

THEORETICAL BACKGROUND

Knowledge Management (KM) Practices in SMEs

In the present study, we focus on two types of KM practices: *external knowledge acquisition* and *internal knowledge sharing*. Previous studies show that they both play an important role in managing and organizing a firm's external knowledge and internal knowledge (Andersen and Drejer, 2008; Hargadon and Sutton, 1997; von Hippel, 1988).

Compared to large firms, SMEs are less likely to have extensive research and development programs and thereby they limit their in-house knowledge creation capacity. Instead, knowledge in SMEs is more likely to be gained through the experiences and associated tacit and explicit learning of specific individuals (Carson and Gilmore, 2000; Wong and Radcliffe, 2000). Many SMEs acquire new knowledge through individual interaction or social ties with external sources. Knowledge can be transferred either by individuals directly, for instance via the acquisition of a new worker who brings in knowledge and experience into the firm and/or through the exchange of information between existing employees and external contacts.

Though external acquisition of knowledge is important, internal knowledge sharing is also viewed as an important practice for transferring externally acquired or internally generated knowledge between individuals within a firm (Van Wijk et al., 2008). Evidence shows that internal knowledge sharing practices provide competitive benefits to firms (Gupta and Govindarajan, 1986). Whereas large firms often focus on IT solutions, internal knowledge sharing in SMEs is typically people-based (Desouza and Awazu, 2006). The reason for the emphasis on these people-based

approaches may be because much of the knowledge in SMEs remains tacit. Given its lack of codification, tacit knowledge can be more easily *externalized*, that is the process for unlocking tacit knowledge and making it explicit through individual interactions (Davenport and Prusak, 1998; Nooteboom, 2001; Nonaka and Toyama, 2003). Despite resource limitations compared to large firms, SMEs typically have several advantages that make knowledge sharing easier, such as a flatter structure, shorter communication lines and direct involvement by top management and/or owners in the activities of the firm (Wong and Aspinwall, 2004). Regarding the involvement of entrepreneurs, furthermore, Wiklund and Shepherd (2003) find that SMEs rely heavily on their individual expertise. Thus, KM practices that enhance the knowledge base of an SME's directors may have a particularly significant effect on the firm's overall innovation performance.

Knowledge Capacities

Here we examine two relevant knowledge capacities – absorptive capacity and transformative capacity. Some researchers refer to *absorptive capacity*, rather broadly, as the firm's ability to value new external knowledge, assimilate it and apply it to commercial ends (Cohen and Levinthal, 1990). In a recent paper, however, Lichtenthaler and Lichtenthaler (2009) suggest that a fine-tuning of the absorptive capacity concept may be useful. They suggest that absorptive capacity would be viewed as only one of several knowledge capacities which they categorize based on the phase of the knowledge management process being addressed (i.e. exploration or acquisition, retention, and exploitation or application) and on the source of knowledge (intrafirm vs. interfirm) being processed. Adopting their model, we define absorptive capacity more narrowly as the firm's ability to acquire external knowledge.

Transformative capacity, the second knowledge capacity we examine, emphasizes a firm's ability to assimilate and retain internal knowledge among employees over time (Garud and Nayyar,

1994; Lane et al., 2006; Lichtenthaler and Lichtenthaler, 2009; Walsh and Ungson, 1991). Knowledge retention needs to be actively managed in order to keep the necessary knowledge available inside a firm (Campbell, 1960; Lane et al., 2006). By doing so, a firm will be less influenced by the knowledge loss caused by termination of a particular skill or routine, or when an employee leaves the firm (Szulanski, 1996; Walsh and Ungson, 1991). Furthermore, transformative capacity emphasizes a firm's ability to reactivate and synthesize existing knowledge with new knowledge. This newly transformed knowledge, in turn, needs to be internalized and assimilated again (Pandza and Holt, 2007; Nonaka, 1994). A dynamic process of maintaining and reactivating knowledge is thus at the core of the transformative capacity concept. We assume that internal knowledge sharing practices represent one set of routines to enhance transformative capacity.

Operationalizing knowledge capacities poses a major challenge for researchers (Kim, 1998; Lane et al., 2006; Todorova and Durisin, 2007; Zahra and George, 2002). As noted by Lane et al (2006), using R&D expenditure for instance, seems to be a rather static indicator for measuring absorptive capacity and a particularly inappropriate pointer in the context of SMEs given the relatively limited amount of formal R&D that takes place in such firms. Adopting a modified version of Zahra and George's (2002) approach, which contrasts the concepts of *potential* and *realized* absorptive capacity, we treat KM practices as *potential* knowledge capacities. The actual underlying knowledge capacities (e.g. absorptive or transformative) can be viewed then as *realized* knowledge capacities (see Figure 1). A combination of these *potential* and *realized* knowledge capacities, in turn, represents some of the knowledge-based dynamic capabilities. Note that in this study, we treat the *realized* knowledge capacities (absorptive and transformative capacities) as unobserved variables.

INSERT FIGURE 1 ABOUT HERE

Innovation Performance and Innovation Orientation

Innovation represents the utilization or commercialization of knowledge that creates something new and offers economic value. In the present paper, we focus on product and/or service innovations that are both new to the market and new to the company. To avoid dilution of focus, we intentionally exclude other classifications such as process innovation, organizational innovation, management innovation, and commercial/marketing innovation (Trott, 1998). This approach is consistent with findings of Johannessen et al (2001), stating that the critical dimension of innovation (for SMEs) is the variation in newness or novelty, the distinctions between types of innovation being less important.

We further distinguish between the outputs (i.e. innovation performance) and the intentions or strategies to create or renew products or services (i.e. innovation orientation). In the present study, *innovation orientation* refers to the focus of individuals within the firm, including its employees and management, on investment and promotion of new products and processes, as well as encouragement of innovative thinking amongst employees (Homburg, et al., 2002; Kundu and Katz, 2003; Siguaw et al., 2006; Worren et al., 2002). Note that innovation orientation may encompass intentional or deliberate as well as emergent strategies for creating new products and services (Mintzberg et al., 1998).

HYPOTHESES AND RATIONALE

We provide a detailed description of the proposed framework of this paper in this section (see Figure 1). SMEs can develop and renew their absorptive capacity and transformative capacity (i.e. their *realized* knowledge capacities) by actively implementing external knowledge acquisition and internal knowledge sharing practices (i.e. their *potential* knowledge capacities). These capacities form the basis for certain knowledge-based dynamic capabilities, which in turn enhance the innovation orientation and innovation performance of the firm. We presume, furthermore, that innovation orientation mediates the relationship between KM practices (as concrete indicators of potential knowledge capacities) and innovation performance.

According to our model, KM practices are routines based on recurring patterns of behaviors within the firm—aggregations of the individual actions and interactions which relate to the acquisition or sharing of knowledge. This provides the logic for seeing the links between the micro-foundations of such routines and the routines themselves (Abell et al., 2008). A firm's (realized) knowledge capacities are dynamically developed over time by way of these KM practices (Campbell, 1960; Floyd and Wooldridge, 1999; Lichtenthaler and Lichtenthaler, 2009). We elaborate further on the rationale and implied hypotheses in the remainder of this section.

External Knowledge Acquisition, Absorptive Capacity and Innovation Performance

We view external knowledge acquisition practices as a key to innovation. The accumulation of external knowledge brought about by such practices can enhance the firm's ability to evaluate the commercial value of technological advances. Such knowledge can also help the firm to learn about competitors and opportunities and as such more effectively position itself in the market place. Such knowledge consequently increases the possibilities of recognizing and developing new technological opportunities for the firm (Teece, 2007). Though not measured directly, the quality of

a firm's absorptive capacity in turn, depends on the intensity and speed of a firm's efforts to identify and gather knowledge, as well as the quality of information gathered. External knowledge acquisition practices foster this capacity through formal and informal networks (Zahra and George, 2002).

Past research suggests that outside sources of knowledge are often crucial to the innovation process (Pierce and Delbecq, 1977). Ravasi and Turati (2005) indicate that technology is generally transferred into a SME rather than developed in-house. Compared to large firms, exploring external sources of knowledge is especially important for SMEs due to their resource constraints (Desouza and Awazu, 2006). External knowledge acquisition represents thus an important means to create new knowledge. Put another way, external acquisition allows firms to learn something different from what they already know (Cohen and Levinthal, 1989). Furthermore, external knowledge may also play a role in building internal connections. The more external knowledge is acquired, the more existing (i.e., internal) knowledge can be reconfigured to foster new competitive advantages (Cohen and Levinthal, 1990).

In sum, firms engaging in external communication react openly to the changing environment—that is, they are more likely to be open to new ideas and to perceive new opportunities—and thus be more inclined to innovate. Hence we propose the following hypothesis,

Hypothesis 1: External knowledge acquisition practices contribute positively to a firm's innovation performance by enhancing a firm's absorptive capacity.

Internal Knowledge Sharing, Transformative Capacity and Innovation Performance

Transformative capacity emphasizes a firm's ability to reactivate and synthesize or combine existing knowledge with new knowledge, and to further internalize and assimilate this newly transformed knowledge (Garud and Nayyar, 1994). Transformative capacity in a firm is important

for recognizing new business opportunities. In practice it requires the communication of generated knowledge to all relevant departments and individuals (Liao et al., 2003).

The quality of a firm's transformative capacity results from effective internal knowledge sharing practices that allow a firm to analyze, process, interpret and understand the knowledge acquired from external sources or reconfigured within a firm (Kim, 1998; Szulanski, 1996). Complementary to absorptive capacity, transformative capacity plays a rather important role in creating a sustainable competitive advantage when a firm's innovation performance relies heavily on cumulative knowledge and entry timing, and when a firm operates in a more dynamic market (Garud and Nayyar, 1994).

Furthermore, transformative capacity reflects the degree to which *common knowledge*, that is, shared information or ideas, is widespread in the organization (Dixon, 2000). Common knowledge is important due to its role in integrating knowledge, which in turn enhances a firm's ability to reactivate and utilize knowledge (Grant, 1996). Researchers have observed that firms must continuously leverage and recombine knowledge for new product development (Kazanjian et al., 2001). The *knowledge creation process*, that is, the effective application of new and/or existing knowledge (Huber, 1991), requires understanding by individuals within the firm as well as the sharing of knowledge amongst individuals with unique or specialized skills. As the knowledge creation process becomes embedded in routines, innovation should become more efficient—that is, the cost of developing innovation decreases, and the innovation activities in turn increase. Therefore, we assume that the greater use of internal knowledge sharing practices facilitates the speed and effectiveness of the innovation process (Liao et al., 2003).

In sum, it is likely that internal knowledge sharing practices not only create common knowledge among individuals which in turn stimulates innovation, but also facilitate innovative

ideas generated by individuals during formal and informal discussions with each other. In turn, at an aggregate level, the degree to which internal knowledge sharing practices are embedded within the firm should result in a higher level of innovation performance at the firm level. Hence we propose the following hypothesis,

Hypothesis 2: Internal knowledge sharing practices contribute positively to a firm's innovation performance by enhancing a firm's transformative capacity.

The Role of Innovation Orientation as a Mediator

Attitude of the management team towards innovation is an important determinant of innovation performance (Nabseth and Ray, 1974). At an individual level of analysis, behavioral intentions are often viewed as a precursor for actual behavior (Fishbein and Ajzen, 1975; Wicker, 1969). In this study, we make inferences at the aggregated level of individual intentions. Since most of our observations are small firms led by individual entrepreneurs, this is probably a reasonable assumption, though we acknowledge that we are transferring this concept to a different level of analysis (from an individual level to a firm level).

Our rationale to support the mediating effect of innovation orientation is incomplete however without explaining the link between KM practices and innovation orientation. Mintzberg et al (1998) compares the deliberate and emergent strategy approaches, the former in keeping with the view that strategy results from the realization of explicit intentions (in this case, innovation) (Berthon et al., 1999). However, according to the emergent perspective of strategy, and in keeping with evolutionary theory, new strategies can grow from the interaction between established routines and novel situations, creating an important source of learning (Mintzberg et al., 1998, p. 185). According to the emergent strategy perspective, strategies emerge as individuals or groups of people learn more about a situation. Based on this logic, we would expect external knowledge

acquisition practices to be a particularly rich basis for interaction between routines and novel situations. We furthermore propose that this can also take place with internal sharing, especially if the backgrounds and knowledge of the different members of the SME are sufficiently diverse. To summarize, we thus argue that innovation orientation plays a mediating role in the relationship between both types of KM practices (external knowledge acquisition and internal knowledge sharing) and innovation performance.

Hypothesis 3a: Innovation orientation is likely to mediate the relationship between external knowledge acquisition and innovation performance.

Hypothesis 3b: Innovation orientation is likely to mediate the relationship between internal knowledge sharing and innovation performance.

METHODOLOGY

Sample and Data Collection

This paper uses a sub-sample of firm-level data from ‘SME Business Policy Panel’ that has been tracked longitudinally by EIM Business Policy and Research since 1998. The total panel consists of about 2000 SMEs and is stratified according to sectors (manufacture, construction, retail and wholesale, and service, according to BIK (Dutch Industrial Classification Chambers of Commerce) codes and size classes (0-9, 10-49 and 50-99 employees in FTEs).

For this particular study, we collected data to measure the key independent variables (KM practices and innovation orientation) via telephone (computer-aided) interviews in 2006. Using the same method, we collected data for the dependent variable (innovation performance) in 2007. By doing so, we eliminated the risk of common method bias with respect to the dependent variable.

We also adopted a key informant approach for this study (Kumar et al., 1997) by interviewing the SME director in each case. Though this approach might lead to a single-response bias (Golden, 1992), our approach also benefits from direct measure of the perceptions of the director.

The target group of this particular study includes only independent companies with at least four employees from all sectors. This resulted in a sample of 649 firms available for empirical analysis. Within the sample, about 50% of respondent firms are less than 18 years old; about 50% of our sample is in the service sector. Regarding size, about 47% of respondent companies have 4-9 employees; 38% have 10-49 employees and the remaining 15% have 50-99 employees. Thus, the sample is somewhat overrepresented by relatively young and small companies in the service sector. However, controlling for company age, size and sector differences is expected to offset this problem, at least in part.

Models to Be Tested

In order to test the proposed hypotheses, we estimated the following models:

$$InnoPerf = \beta_0 + \beta_1 \cdot ExterA + \beta_2 \cdot InterS + \beta_3 \cdot Context + \varepsilon \quad (1)$$

$$InnoPerf = \beta_0 + \beta_1 \cdot ExterA + \beta_2 \cdot InterS + \beta_3 \cdot InnOri + \beta_4 \cdot Context + \varepsilon \quad (2)$$

Where *InnoPerf* represents innovation performance, *ExterA* represents external knowledge acquisition practices, *InterS* represents internal knowledge sharing practices, *InnOri* represents innovation orientation, and *Context* represents a set of contextual control variables (including company size, company age and sector dummies).

Variables

Scale construction. To construct multi-item variables, we used a combination of techniques, including Exploratory Factor Analysis, testing for reliability using the Cronbach-alpha reliability coefficient (See Table I), and a check for face validity. Items were combined into variables using a protocol referred to as categorical principal components analysis (CATPCA) executed using the Statistical Package for the Social Sciences (SPSS). Appendix A provides a more extensive description of each variable.

INSERT TABLE I ABOUT HERE

Innovation performance. Three items, measuring whether the firm has introduced or developed new products or services (both new to the market and new to the firm), are combined into a scale for innovation performance using CATPCA (See Table I) (Cronbach's $\alpha = 0.64$).

KM practices. For all the KM practices, items are measured on a five-point disagree/agree scale. Five items assess the intensity and direction of efforts expended in external knowledge acquisition (Cronbach's $\alpha = 0.80$) and three items measure internal knowledge sharing (Cronbach's $\alpha = 0.63$) (See Appendix A). These items draw from the existing literature regarding knowledge management in SMEs (Uit Beijerse, 2000; Wong and Aspinwall, 2005). Similar items were used for the empirical study of the dimensions of potential absorptive capacity (Jansen et al., 2005).

Innovation orientation. Innovation orientation is based on a three item scale (Cronbach's $\alpha = 0.62$). This scale captures information regarding behavioral intentions of the director and/or employees towards innovation.

Control variables. We use company size, age and sector dummies, as control variables in our empirical analysis. Company size is measured by the natural logarithm of the number of employees in 2006. Four sectors are defined: manufacturing, construction, retail and wholesale, and services. Age is measured by the difference between the founding year and 2006.

Common method bias tests. Although reliabilities of scales in some cases are somewhat lower than desired, results from the common method bias test support the conclusion that each scale measures a separate construct (Podsakoff and Organ, 1986; Tippins and Sohi, 2003). More specifically, results were checked via an orthogonally rotated Principal Components Analysis (PCA) including individual items for KM practices, innovation orientation and innovation performance.

Based on Harman's single-factor test, results show that items for each of the two KM practices (external knowledge acquisition and internal knowledge sharing), innovation orientation and innovation performance all load on separate factors (See Table I). In the unrotated solution, the largest factor explains only 26% of total variance. Furthermore, component loadings range from 0.57 to 0.80, with an average statement loading on the intended construct of 0.69. Of the 42 potential cross-loadings, only two loadings are above 0.30 (one being 0.41, the other 0.32). Together with the fact that innovation performance is measured in a separate year, these findings provide reasonable confidence that the common method bias is not a major problem in the current study (Podsakoff et al., 2003).

Data Analysis

Initial tests. Bivariate relationships are first examined using Pearson product-moment bivariate correlation statistics. As a prior step to multivariate Ordinary Least Squares (OLS) regression analysis, we checked for multicollinearity using Variation Inflation Factors (VIF) scores.

To test Hypotheses 1 and 2: we first carried out a multivariate OLS regression analysis. To test Hypotheses 3a and 3b: we followed the procedures to test for mediation described by Frazier et al (2004), and used the Sobel Test to check for significance (Frazier et al, 2004).

Structural equation modeling. As a further test of all the hypotheses, we use structural equation modeling (i.e. AMOS). A distinct advantage of structural equation models is the inclusion of latent variables, which allows for the measurement of abstract concepts that are not measured directly. In the present study, such latent variables are two aspects of KM practices (external knowledge acquisition and internal knowledge sharing), innovation orientation and innovation performance.

The overall fit of the structural equation model is checked by using chi-square (χ^2), degrees of freedom (df), and a probability estimate (p-value). The chi-square value should *not* be significant if there is a good model fit. In addition, the following indices are also commonly used to evaluate the model fit: relative chi-square or normal chi-square ($\text{CMIN/DF} \leq 3$); goodness of fit (GFI) which checks for sample size effects and should be above 0.90; CFI, a comparative fit index, which checks for non-normal distribution should be above 0.90; and the root mean square error of approximation (RMSEA). The last index, RMSEA measures population discrepancy per degree of freedom and should be below 0.05 (Hu and Bentler, 1999; Murtha et al., 1998). Finally, when models are estimated using maximum likelihood estimation, it is also appropriate to use the Akaike information criterion (AIC), Bayes information criterion (BIC) and consistent AIC criterion (CAIC) to evaluate goodness of fit (Benetti and Kambouropoulos, 2006). These three values for the hypothesized model should be smaller than for the saturated and independence models.

RESULTS

Table II presents descriptive statistics and correlations among all variables used in the study. Model 1 of Table III presents the regression results on the relationship between KM practices and innovation performance; Model 2 presents the influence on this relationship due to mediating effect of innovation orientation. We also calculated VIF scores for each of the regressions to assess multicollinearity. The VIF scores range from 1.04 and 1.30. Given the rule of thumb cut-off of 10 (Neter et al, 1990), we can conclude that multicollinearity is unlikely to be an issue.

INSERT TABLE II ABOUT HERE

Hypothesis 1 predicts a positive relationship between external knowledge acquisition and innovation performance through enhancement of absorptive capacity (an unobserved variable in this study). Model 1 of Table III shows a significant positive coefficient for external knowledge acquisition ($B=0.17$, $p<0.01$). Thus, Hypothesis 1 is supported. Similar prediction has been made for internal knowledge sharing on innovation performance (Hypothesis 2). However, the coefficient for internal knowledge sharing is not significantly (only a trend) related to innovation performance ($B=0.07$, $p<0.1$). Hypothesis 2 is therefore not supported.

INSERT TABLE III ABOUT HERE

Hypotheses 3a and 3b predict the mediating effect of innovation orientation between KM practices (external knowledge acquisition and internal knowledge sharing) and innovation performance. When we add innovation orientation in model 2, the significant effects of both

external knowledge acquisition and internal knowledge sharing disappear but model 2 shows a significant positive coefficient for innovation orientation ($B=0.36$, $p<0.01$) (see Table III, Model 2). Using the Sobel Test for mediating effects, we find best support for the conclusion that the relationship between external knowledge acquisition and innovation performance is mediated fully by the innovation orientation variable (see Model a of Figure 2, Sobel test $z=6.61$, $p<0.01$). However, we do not find the same mediating effect for the relationship between internal knowledge sharing, transformative capacity and innovation performance (see Model b of Figure 2, Sobel test $z=0.99$, ns). Hypothesis 3b is thus not supported. One possible explanation could be that only certain SMEs benefit from internal knowledge sharing, namely those that rely heavily on cumulative knowledge or operate in more dynamic environments or under other specific conditions (Garud and Nayyar, 1994).

INSERT FIGURE 2 ABOUT HERE

Results according to Structural Equation Modeling (SEM)

As an alternative approach to test the overall model, we also applied structural equation modeling. The results of SEM are reported in Figure 3. Note that the chi-square of the hypothesized model is 122.19, with 112 degrees of freedom, p-value is 0.24, which is not significant. Based on convention, (and perhaps counter-intuitively), a structural equation model is considered a good fit when the null hypothesis can be accepted (thus chi-square being non-significant as in the present case). Thus, the model is accepted as a good fit of the data. The other key statistical measures of the hypothesized model support that there is good model fit (see Figure 3). The CMIN/DF is 1.09, the

GFI is 0.98, the CFI is 0.99 and the RMSEA is 0.01. We can thus conclude that the model is valid and proceed to interpret its results.

Indicators measuring each latent variable of this study are all highly statistically significant ($p < 0.001$). Results confirm that indicators load only on the constructs to which they belong. Furthermore, path analysis shows that external knowledge acquisition ($B = 0.40$, $p < 0.001$) has a positive effect on innovation orientation but that internal knowledge sharing ($B = -0.51$, ns) has no significant effect. There is also no significant relationship between either of the KM practices and innovation performance. Innovation orientation positively contributes to innovation performance ($B = 0.33$, $p < 0.001$). Thus, consistent with conclusions drawn from the multivariate OLS regression analysis, our results show a significant mediating effect of innovation orientation in the relationship between external knowledge acquisition and innovation performance while internal knowledge sharing is associated neither with innovation orientation nor innovation performance (See Figure 3).

INSERT FIGURE 3 ABOUT HERE

DISCUSSION AND CONCLUSION

The aim of this study is to investigate how SMEs foster innovation within their firms. Taking a knowledge-based dynamic capabilities perspective, we empirically test the relationship between KM practices, innovation orientation and innovation performance based on a sample of 649 Dutch SMEs. We argue that the effects of KM practices on innovation performance take place by enhancing a firm's realized knowledge capacities. Combining results from multivariate OLS regression analysis and SEM, our results most clearly support the conclusion that only external

knowledge acquisition contributes positively to innovation performance of a SME and presumably via the enhancement of absorptive capacity. Furthermore, the results are most consistent with the conclusion that internal knowledge sharing, on the other hand, is not associated with innovation performance. These findings would appear consistent with other research views that external knowledge acquisition practices (but not necessarily internal sharing practices) are an essential determinant especially in new product innovation for SMEs (Kazanjian et al., 2001).

Moreover, we empirically test and find support for the mediating effect of innovation orientation in the aforementioned relationship (see Figure 1). The full mediating role of innovation orientation in the relationship between external knowledge acquisition, absorptive capacity and innovation performance is consistent with the predictions made in Hypothesis 3a. One interpretation of this result is as follows: Directors and other key employees of SMEs reporting more extensive use of external knowledge acquisition practices in their firms are likely to obtain more knowledge from outside the firm, and thus likely to build up greater absorptive capacity. This in turn, may enhance their judgments with respect to new and/or existing opportunities. Our evidence suggests that such knowledge also enhances the innovation intentions or orientation of individual employees within the firm, which leads to higher innovation performance. These findings are in keeping with an emergent view of strategy as proposed by Mintzberg et al (1998).

Weaker support is found for the role of internal knowledge sharing in the SME's innovation performance. Perhaps many SMEs are simply too small or the diversity of their internal expertise too limited to benefit from such sharing. Or perhaps there are contingencies for which such sharing is less effective with respect to innovation.

Implications

The key findings of this study demonstrate the importance of external knowledge acquisition versus internal knowledge sharing in fostering innovation orientation and innovation performance within SMEs. Empirical evidence shows that a disproportionate amount of innovation (including new patents and other inventions and discoveries) comes from SMEs (Acs, 1996; Thompson and Leyden, 1983). Our study suggests that SMEs may innovate in different ways than large firms. Instead of building new knowledge and creating innovation opportunity in-house, SMEs often seek opportunities and acquire new external knowledge through social ties and interaction with external resources. A favorable external communication system can make SMEs more innovative, perhaps by improving their ability to identify new opportunities from the external environment.

This is in line with the dynamic capabilities perspective, which argues that a firm's competitiveness depends on its dynamic capabilities, that is, its capacity to sense and shape opportunities and threats (Teece, 2007). Amongst SMEs, external knowledge acquisition strategies are especially helpful and appear to foster innovation. Therefore, policy makers who want to stimulate SMEs' innovation performance may want to assist SME directors in making better use of their external environment by learning how to network more effectively. Indeed, recent small-scale experiments with Dutch agricultural entrepreneurs over a six-month period provide support for the feasibility of networking workshops (Verstegen and de Lauwere, 2009).

Furthermore, findings from our study support the notion that organizational routines may represent recurring patterns of activities taken by individuals within the organization, such as joining networks, attending seminars and conferences, and that such activities have a direct positive effect on innovation orientation and innovation performance of the firm in turn. Although better tests are needed, these findings are consistent with the notion that actions of individuals have a

direct impact at the aggregate or firm level outcomes. In turn, such actions, in our view, may be considered the micro-foundations for the routines that can lead to the firm's (realized) knowledge capacities (e.g. absorptive, transformative) at the organization level.

Finally, one of the most interesting findings may be the mediating effect of innovation orientation in the relationship between external knowledge acquisition practices and innovation performance. These findings provide support for a combined emergent and deliberate view of innovation strategy. On the one hand, external exposure to ideas appears to enhance learning and interest in strategic renewal and innovation (i.e. emergent view). External knowledge search activities appear to make SMEs more inclined in other words, to engage in innovation activities, and perhaps realize the benefits of innovation. On the other hand, a heightened innovation orientation is clearly related to greater innovation performance during a subsequent period, supporting a deliberate view of strategy as planned and based on behavioral intentions. This combined emergent-deliberate view is in keeping with a view of strategy proposed by Mintzberg, et al (1998).

Limitations and Future Research

This study has certain limitations that might be addressed by future research. First of all, we measure KM practices as potential knowledge capacities but only infer the existence of realized knowledge capacities as unobserved intervening variables. For instance, since transformative capacity is unobserved, based on our methodology, we cannot conclude whether our findings are due to a lack of effect of sharing practices or the irrelevance of transformative capacity for SMEs. One way to solve this problem in future research would be to design direct measures of realized knowledge capacities. For instance, a future measure of absorptive capacity might assess the adequacy of external information acquired, in terms of various dimensions (e.g. quantity,

timeliness, appropriateness for solving of internal problems). We do question, nevertheless, the way absorptive capacity has been measured in the past, especially those studies which measure absorptive capacity as the amount or proportion of capital allocated to research and development (Cohen and Levinthal, 1990; Cantner and Pyka, 1998; Rocha, 1999; Stock et al., 2001). Capital itself is a resource, not a capacity, per se.

In addition to the variables examined in this study, the prediction of innovation performance could be strengthened by including a more complete set of KM practices in future research to reflect a broader range of knowledge capacities as identified by other recent research (e.g. Lichtenhaler, 2009; Lichtenhaler and Lichtenhaler, 2009). Other independent variables might also include human capital variables, such as aggregates of employee and/or director characteristics such as aptitude, creativity, knowledge, education and work experience.

We realize the limitation of having only one key informant per firm. Future research may also focus more explicitly on micro-foundations of routines, for instance, by obtaining self-reports of KM practices from individual members of each firm, in addition to the director as key informant. Although obtaining multiple respondents data per firm is challenging, it would allow for a more rigorous testing of the micro-foundations approach to the dynamic capabilities perspective. Asking respondents not only their own behavior but also their perception of the dominant or accepted behaviors in the firm would also provide measurement of descriptive norms regarding KM practices.

One final area to explore in future research is the examination of the model on a time-series basis. Although there is a one-year lag between the independent and dependent variables, the dependent variable by its nature measures retrospective information from the previous year, thus not providing much time delay. Measurement of all variables for several time periods could thus be

conducted to provide a more thorough means to test the assumptions of emergent versus deliberate strategy.

In conclusion, our study responds to calls for research on origins of organizational routines and capabilities, and their relationships to firm-level outcomes. The present paper contributes to the management literature on knowledge management, dynamic capabilities, emergent versus deliberate strategy and emerging micro-foundations approaches in the following ways: *first*, providing empirical insight into how SMEs foster their innovation from a knowledge-based dynamic capabilities perspective; *second*, revealing a combined emergent-deliberate view of innovation strategy for SMEs by testing mediating effect of innovation orientation; and *last*, creating a link between individual action and firm-level routines or capabilities by focusing on KM practices as recurring patterns of individual behaviors.

Furthermore, our empirical findings imply that SMEs can be innovative in spite of their (potential) resource constraints. SMEs which actively acquire external knowledge are able to build a greater competitive absorptive capacity to sense and seize business opportunities. This in turn may motivate them to be proactive in innovation activities, and hence leads to new or improved products or processes. Thus, by strategically managing knowledge management and especially external knowledge acquisition practices, owners/entrepreneurs of SMEs and their firms will benefit in the long term.

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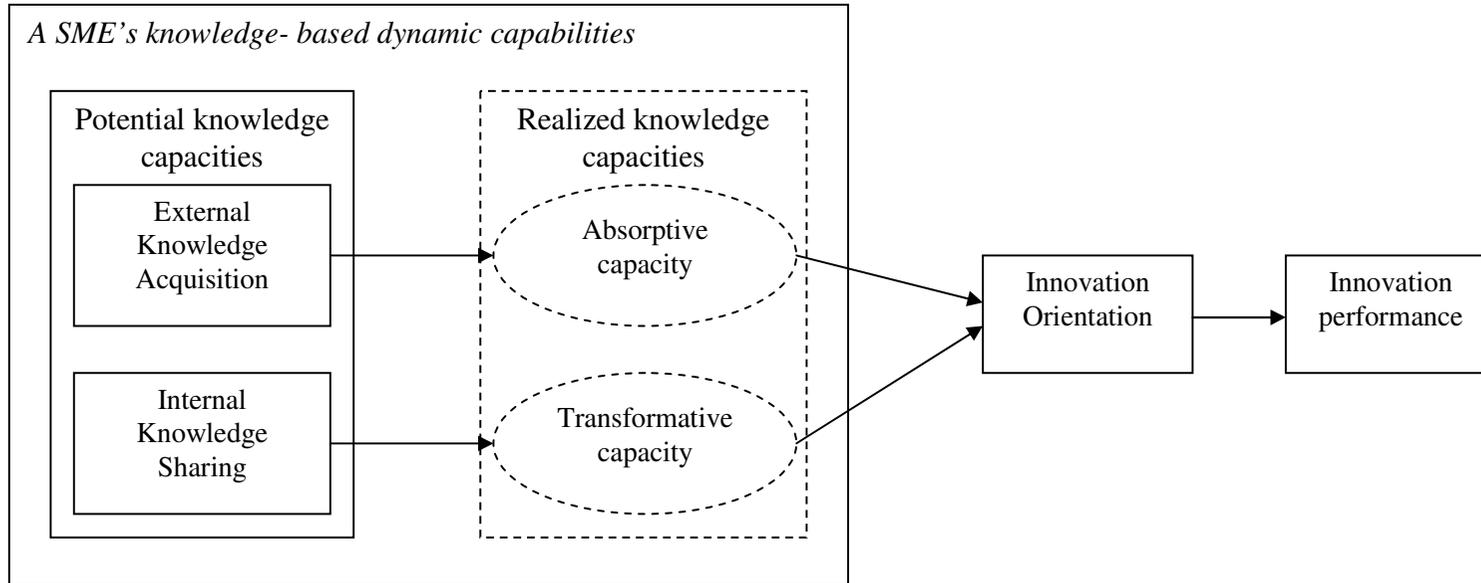
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Figure 1. Proposed research framework

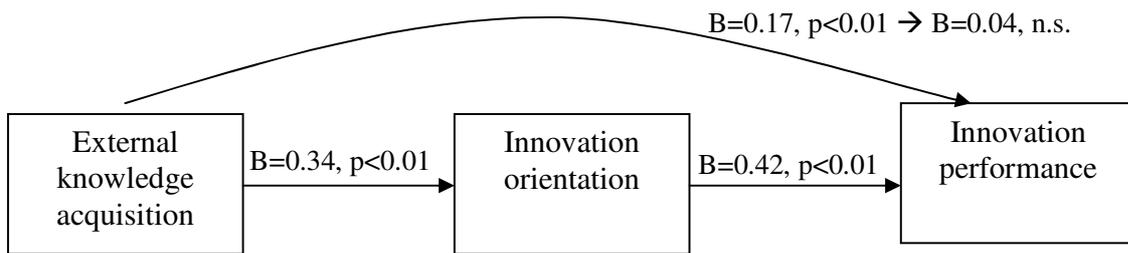


Note: dash line --- means unobserved in this study.

Figure 2. Mediating effect of innovation orientation on the relationship between knowledge management practices and innovation performance (n=649)

a) External knowledge acquisition and innovation performance

Sobel test: $z=6.61, p<0.01$



b) Internal knowledge sharing and innovation performance

Sobel test: $z=0.99, p=0.32$

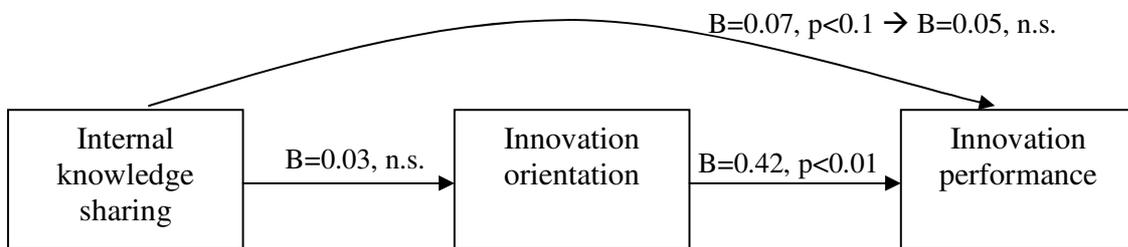
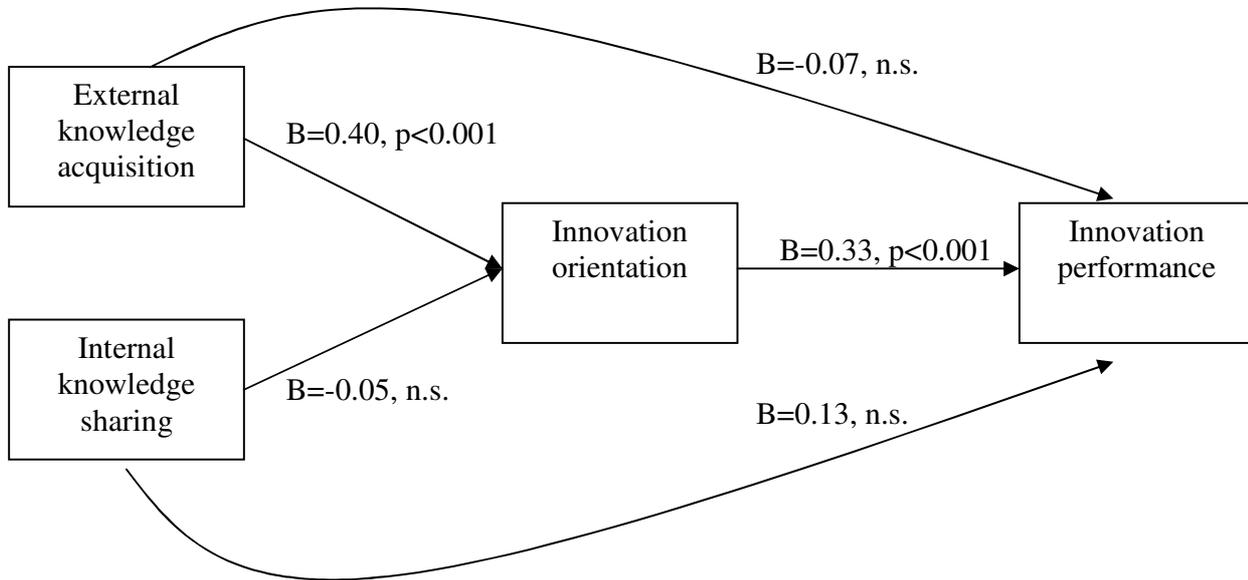


Figure 3. Results of Path Analysis (n=649) from SEM model



Constructs loadings in the Structural Model

		Estimate	S.E.	C.R.
vluh01eR	<--- External knowledge acquisition	1.00		
vluh01dR	<--- External knowledge acquisition	0.93 ^{***}	0.10	9.04
vluh01bR	<--- External knowledge acquisition	1.10 ^{***}	0.10	10.59
vluh01aR	<--- External knowledge acquisition	0.92 ^{***}	0.10	8.93
vluh01cR	<--- External knowledge acquisition	1.12 ^{***}	0.10	10.76
vluh03dR	<--- Internal knowledge sharing	1.00		
vluh03bR	<--- Internal knowledge sharing	2.58 ^{***}	0.43	6.01
vluh03aR	<--- Internal knowledge sharing	1.64 ^{***}	0.25	6.69
vd02cR	<--- Innovation orientation	1.54 ^{***}	0.16	9.92
vc02aR	<--- Innovation orientation	0.48 ^{***}	0.05	9.82
vf01aR	<--- Innovation orientation	1.00		
vta_02R	<--- Innovation performance	1.00		
vta_04R	<--- Innovation performance	1.56 ^{***}	0.17	9.23
vta_03R	<--- Innovation performance	0.83 ^{***}	0.10	8.79

Model fit summary: $\chi^2=122.19$, $df=122$, $p=0.24$

	CMIN/DF	GFI	CFI	RMSEA	AIC	BIC	CAIC
Hypothesized model	1.02	0.98	0.99	0.01	278.19	627.28	705.28
Saturated model		1.00	1.00		380.00	1230.33	1420.33
Independence model	11.81	0.65	0.00	0.13	2056.69	2141.72	2160.72

[†] $P < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$

Table I. Results of Common Method Bias Test for Knowledge Management, Innovation Orientation and Innovation performance

		Component				
		1	2	3	4	
Knowledge Management	External Knowledge Acquisition	Our company collaborates with other organizations (companies, universities, technical college) through alliances.	0.69	-0.04	0.17	-0.01
		The organization encourages employees to join formal or informal networks outside the organization	0.67	0.16	0.16	0.04
		Sending employees to exhibitions, congresses or seminars on a regular basis.	0.72	0.10	0.11	0.06
		Staying in touch with professionals and experts outside the company	0.60	0.16	0.21	-0.09
		To stay in touch with new developments, our company hires new employees with particular expertise.	0.63	0.15	-0.11	0.22
	Internal Knowledge Sharing	Director (management) holds frequent meetings with employees to share recent discoveries and insights.	0.14	0.72	0.12	0.09
		The company has special procedures or other ways to guarantee the sharing of best practices among members of the organization.	0.32	0.57	0.12	0.06
		Employees share knowledge and experience by talking to each other.	0.01	0.79	-0.01	-0.02
	Innovation Orientation	Would you describe your strategy as renewing products, services or processes?	0.12	0.03	0.75	0.08
		Within our company people are constantly thinking about new products or services that serve future needs	0.11	0.17	0.73	0.10
Are you going to invest in new products or services in the next 12 months		0.24	0.00	0.59	0.27	
Innovation performance	Has the company introduced products or services to the market in 2006 that were new to the market.	0.07	0.11	0.41	0.63	
	Has the company introduced products or services to the market in 2006 that were new to the company	0.03	0.03	-0.03	0.80	
	Has the company developed new products or services in 2006	0.04	0.02	0.22	0.72	
Cronbach's alpha		0.80	0.63	0.62	0.64	

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

Table II. Mean, standard deviation and Pearson correlations for all variables in the study (n=649)

	1	2	3	4	5	6	7	8	9
1. Innovation performance	1.00								
2. Innovation orientation	0.41***	1.00							
3. External knowledge acquisition	0.18***	0.39***	1.00						
4. Internal knowledge sharing	0.08	0.07	0.10*	1.00					
5. Size	0.09*	0.19***	0.29***	-0.11**	1.00				
6. Age	-0.03	-0.01	0.05	-0.05	0.25***	1.00			
7. Manufacturing sector	0.23***	0.10*	-0.06	-0.04	0.08*	0.11***	1.00		
8. Construction sector	-0.17***	-0.20***	-0.08*	-0.07	0.00	0.06	-0.18***	1.00	
9. Retail & wholesale sector	0.00	-0.05	-0.09*	-0.02	-0.20***	-0.06	-0.22***	-0.19***	1.00
VIF		1.25	1.30	1.04	1.24	1.09	1.16	1.16	1.18
Mean	0.00	0.00	0.00	0.00	2.58	27.95	0.17	0.14	0.19
Standard deviation	1.00	1.00	1.00	1.00	0.95	27.63	0.38	0.34	0.40

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$, two tailed tests of significance

Table III. Regression Results on Innovation Performance (n=649).

Explanatory variables	Model 1		Model 2	
	b-value	t-value	b-value	t-value
Constant	-0.20	-1.58	-0.13	-1.13
Knowledge management practices				
External knowledge acquisition	0.17**	4.36	0.04	1.07
Internal knowledge sharing	0.07 [†]	1.76	0.05	1.51
Innovation orientation			0.36**	9.20
General context				
Size	0.06	1.42	0.03	0.67
Age	-0.00 [†]	0.08	-0.00	1.39
Manufacturing sector	0.64**	6.09	0.55**	5.54
Construction sector	-0.26*	-2.26	-0.11	-1.00
Retail & wholesale sector	0.16	1.61	0.17 [†]	1.73
R-square	0.11		0.22	
Adjusted R-square	0.10		0.21	

[†] $p < 0.10$; * $p < 0.05$; ** $p < 0.01$, two tailed tests of significance

APPENDIX A: Description of Variables

Variable	Description of Variable
<i>Knowledge management practices</i>	
External knowledge acquisition $\alpha=0.80$	<p>The external acquisition construct was created using CATPCA, using the following five questions:</p> <ol style="list-style-type: none"> 1. Our company collaborates with other organizations (companies, universities, technical college) through alliances. 2. The organization encourages employees to join formal or informal networks outside the organization 3. Sending employees to exhibitions, congresses or seminars on a regular basis. 4. Staying in touch with professionals and experts outside the company 5. To stay in touch with new developments, our company hires new employees with particular expertise. <p>The items were answered with the following scale:(1='not at all applicable'; 2='not all that (barely) applicable'; 3='somewhat applicable'; 4='applicable to a great degree';5='totally applicable')</p>
Internal knowledge sharing $\alpha =0.63$	<p>The internal sharing construct was created using CATPCA, using the following three questions:</p> <ol style="list-style-type: none"> 1. Manager consults employees frequently to discuss new developments. 2. The company has special procedures or other ways to guarantee the sharing of best practices among members of the organization. 3. Employees share knowledge and experience by talking to each other. <p>The items were answered with the following scale: (1='not at all applicable'; 2='not all that (barely) applicable'; 3='somewhat applicable'; 4='applicable to a great degree';5='totally applicable')</p>
<i>Innovation Orientation</i>	
Innovation orientation $\alpha =0.62$	<p>The innovation orientation construct was created using CATPCA, using the following three questions:</p> <ol style="list-style-type: none"> 1. Would you describe your strategy as renewing products, services or processes? (1='no';2='yes') 2. Within our company people are constantly thinking about new products or services that serve future needs

The items were answered with the following scale: (1='not at all applicable'; 2='not all that (barely) applicable'; 3='somewhat applicable'; 4='applicable to a great degree';5='totally applicable')

3. Are you going to invest in new products or services in the next 12 months?
(1='no';2='probably';3='certainly')

Innovation performance

Innovation performance
 $\alpha=0.64$

This scale was created by combining answers to the following three questions using the CATPCA technique:

1. Has the company introduced products or services to the market in 2006 that were new to the market?
2. Has the company introduced products or services to the market in 2006 that were new to the company?
3. Has the company developed new products or services in 2006?
(1='no';2='yes')

Control variables

Size Computed as the natural logarithm of the response to the following question. How many persons does the company employ?

Age Computed as the difference between founding year and 2006.

Manufacturing sector Is the company operating in the industrial sector? (1='yes'; 0='no')

Construction sector Is the company operating in the construction sector?(1='yes'; 0='no')

Retail and wholesale sector Is the company operating in sales or repair of consumer products? (1='yes'; 0='no')
