Does professional knowledge management improve innovation performance at the firm level?

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Abstract

This study investigates how knowledge management influences the innovation performance of a firm. While former studies mainly focused on the difference phases of knowledge processing in the firm, new data allows us to look at it from the perspective of knowledge management techniques. It turns out that there is a difference between the three knowledge management techniques and their influence on product and process innovation. The ability to source external knowledge and possessing a codified knowledge management policy positively affects the firm's introduction of new products. For introducing products new to the market, only external knowledge is beneficial. The availability of a codified knowledge management policy also positively affects the cost reduction possibilities of a firm.

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1. Introduction

Penrose (1959) indicated in the book 'the theory of the growth of the firm' for the first time the importance of resources to the firm which led to the development of the resource based theory of the firm. Traditionally this was based on the view that capital, labor and natural resources are the factors influencing the economic growth to a company or region. Wernerfelt (1984) states that for the resource-based approach of the firm, very specific resources, competencies and capabilities are needed to reposition the firm. Grant (1996) aims at the importance of the management which task is to optimally deploy these resources and capabilities in order to create value and to develop the future resource base of the firm. These idiosyncratic and difficult-to-imitate resources are critical drivers of the firm's competitive advantage which lies upstream of product markets (Teece, Pisano and Shuen, 1997). Thus, resources are the main drivers of value creation. When a firm possesses unique resources, it can create a competitive advantage through an effective and innovative management of these resources and in that way outperform other firms (Penrose, 1959). Penrose already indicated the importance of knowledge but only saw it as a capability of the management and not as a part of the resource-base of the firm: "*there is a close relation between the various kinds or resources with which a firm works and the development of the ideas, experience, and knowledge of its management and entrepreneurs, and we have seen how changing experience and knowledge affect not only the productive services available from resources, but also 'demand' as seen by the firm (p 85).* In the last decades, the awareness of knowledge as an important driver of economic growth has increased. This awareness led to the development of a knowledge-based theory of the firm. To be able to create value, a firm has to possess knowledge with certain characteristics such as transferability, capacity of aggregation, appropriability, specialization in knowledge acquisition and knowledge requirements of production (Grant, 1996). Cohen and Levithal (1990) address the importance of absorptive capacity for a firm which indicates the ability to identify, assimilate and exploit knowledge from the environment. Grant (1996, 1997) characterizes the knowledge-based theory of the firm as an 'outgrowth' of the resource based theory because knowledge is perceived as the strategically most important resource. He argues that this is not yet a theory of the firm: *"there is insufficient consensus as to its precepts or purpose, let alone its analysis and predictions, for it to be recognized as a*

theory." Yet, this knowledge-based view is quite promising related to changing management thinking. A major contribution to the knowledge-based view is the analysis of coordination within the firm. Darroch (2005) agrees on the importance of coordination and management and states that although knowledge is a resource, more can be extracted from knowledge if it is effective management. Carrillo and Gaimon (2004) add to that by stating that the technical systems, workforce knowledge and managerial systems are the knowledge-based resource capabilities of a firm driving performance. The growing importance of the management of these capabilities results from the technology change and intense competition threatening firm performance.
As Penrose (1959) already stated: "*Managers function as a catalyst in the conversion of firm's resources into firm capabilities and new product applications. In the spirit of dynamic capabilities, new combinations of resources lead to innovation and economic value creation* (Korr and Mahoney, 2004)." Thus knowledge alone is not enough to create a competitive advantage. Early reactions to market information and fast and flexible innovation are crucial elements to obtain a competitive advantage (Kohli and Jaworski; 1990). Therefore investments in dynamic capabilities are of significant importance. Eisenhardt and Martin (2000) define dynamic capabilities as *a set of specific and identifiable processes*. To address the changing environments, it is necessary to exploit existing internal and external competences specific related to the firm. Teece, Pisano and Shuen (1997) describe it as an *emerging and potentially integrative approach to understanding the newer sources of competitive advantage.* The capabilities that make it possible to achieve these newer sources of competitive advantage are called 'dynamic capabilities'. Therefore it is important to be flexible and stay up-to date with the changing business environment. An additional requirement is the capacity to renew competences to be able to appropriately adapt, integrate and reconfigure internal and external organizational skills, resources and functional competences to match the changing environments. This makes the knowledge-based theory dynamic.

Together with the growing awareness of the importance of organizational learning and knowledge management amongst practitioners, the interest of academics increased. Research indicates significant differences in performance across firms. Theories of the firm built on this and try to understand the factors which contribute to this performance difference across firms. Research around knowledge management

has sofar mainly focused on the different phase. Argote, McEvily and Reagans (2003) discuss the knowledge management outcomes of the knowledge creation, retention and transfer. Darroch (2005) indicates knowledge orientation as knowledge acquisition, dissemination and responsiveness. Bhatt (2001) defines knowledge management as a process of knowledge creation, validation, presentation, distribution and application. The interaction pattern between technologies, techniques and people is shaped by knowledge management. Kalling (2003) makes an even different distinction, this between the three instances of knowledge namely knowledge development, utilization and capitalization.

We investigate knowledge management from another perspective. Which knowledge management techniques do companies use to increase their performance? Consequently, we investigate the effect of internal knowledge management policy. This concerns a codified knowledge management policy. Here we investigate in which way the attempt to transfer tacit knowledge into codified knowledge increases firm performance. This codification makes it easier to transfer the knowledge across individuals, groups or organizations, which makes the transfer of knowledge less time consuming and intensive and ultimately yields economies of scope. On the other hand, not all knowledge is codifiable. Therefore it is necessary to stimulate employees to cooperate with each other and share information within the company so that present tacit knowledge is distributed. A transfer of tacit knowledge includes *mentorship, apprenticeship and repeated practice over a period of time (*Edmondson, Winslow and Pisano, 2003). In their paper, Menon and Pfeffer (2003) discuss the difference between the appreciations of managers towards the value of internal versus external resources. The Not Invented here Syndrom, perceives the management view where internal relative to external knowledge is highly valued. However, they state that organizational reality contradicts this view frequently. Therefore it is interesting to look at the influence of managing external knowledge on firm performance. This external knowledge generation can be done by specific resources to detect and gather external knowledge or to attract external experts to cooperate with project groups. External experts can be universities, research institutions on the one hand or other companies on the other hand. Veugelers and Cassiman (2001, 2005) and Siegel et al. (2007) investigate the link between science and industry and the influence on innovative performance.

Based on these insights we will try to discover the influence of different management techniques on innovation performance of a firm. Livingstone et al. (1998) describe innovation as "new products or processes that increase value…". We will also make the distinction between product and process innovation to determine the innovation performance of a firm. A firm can conduct product innovation through the introduction of products new to the firm or to the market. An possible advantage of process innovation to a firm may be cost reduction.

In the following section we will discuss earlier research concerning the influence of knowledge management on innovation and overall firm performance. In the third section, the research design is developed in the fourth, the results are summarized. The fifth part provides a conclusion.

2. Literature review

First a short review of different authors who link the effect of knowledge management to innovation is given. Following, the link between innovation, knowledge management and firm performance is made. And finally, there is a summery of research conducted towards the effect of knowledge management on firm performance.

Johannessen, Olsen and Olaisen (1999) state that knowledge and innovation are needed to attain a sustainable competitive advantage. An information asymmetry between firms occurs, so when this is turned into knowledge, the firms which possess more knowledge are given an advantage in ascertaining market inefficiencies. This in turn provides them a better position to innovate (Sveiby, 1997).
Cantner, Joel and Schmidt (2008) focus on knowledge *management practices implemented to increase collaboration between actors with a firm on innovation activities*. They investigate the determinants of knowledge management using a probit model. Knowledge management is defined as *internal modes of collaboration in innovation activities between different departments that involve the exchange of knowledge.* This concerns face-to-face and interacting modes of collaboration. As significant determinants of knowledge management are indicated: consumer orientation, continuous R&D activity, number of employees, high-tech manufacturing

and knowledge intensives services. Their emphasis so is on the demand-based approach of knowledge management for understanding the innovating firm. Knowledge management is indicated as an important tool to manage innovation activities in a way that they help to make the innovation process less uncertain and more targeted.

Darroch (2005) goes a step further and investigates the link between knowledge management and innovation towards firm performance and describes the role of knowledge management as a coordinating mechanism. Knowledge management is measured as knowledge acquisition, dissemination and responsiveness. For innovation, a measure for radical innovation and several measures for incremental innovation are included. Comparative and internally reflective financial and non-financial measures are used to assess firm performance. Correlation analysis indicates that firms that effectively manage knowledge are likely to be more innovative. Though, they do not find evidence for firms managing knowledge to be better performers. Further analyses are done using structural equation modeling. The three knowledge management measures appear to have internally a positive effect on each other. The three measures also positively affect innovation. Though, only responsiveness to knowledge has a positive effect on performance. A possible explanation could be according to Darroch, the large gap between non-market knowledge and performance. The results do not confirm a positive effect between innovation and firm performance.

Lööf and Heshmati (2002) study performance heterogeneity among Swedish firms making a close link between knowledge and innovation. To control as much as possible for selectivity and simultaneity biases, the econometric analysis is based on the CDM model[1]. They find that knowledge capital measured as innovative sales relative to total sales is a significant factor that contributes to differences in performance between firms. This knowledge capital is positively related to innovation input, firm's internal innovation knowledge and the co-operation on innovation with domestic universities. Knowledge intensive firms do not appear to be more innovative relative to labor or capital intensive firms when controlling for differences in

[1] Crépon, Duguet, Mairesse (1998). Research, Innovation, and Productivity: An Econometric Analysis at the Firm Level. NBER Working Paper Series.

innovative investment and human capital. Productivity is negatively influenced by organizational rigidities in innovation projects and a shortage of appropriate investment sources for innovative activities. The size of innovation investment though is positively influenced by an aggressive innovation strategy, customers and resources within the firm.

Decarolis and Deeds (1999) investigate the relationship between stock and flows of organizational knowledge and firm performance in biotech industries. For the knowledge flows they take the geographic location, alliances with other institutions and organizations and R&D expenditures into account. Knowledge stocks represent the products in the pipeline, the firm citations and patents. Because of the characteristics of the biotech industry, measuring the return on assets, sales growth or profit margin seem not to be appropriate since these firms have no history of revenues or earnings. Initial Public Offerings are used as a critical point in evaluating firm performance. They state that *the value place on a newly public firm is the market's evaluation of the firm's performance over its lifetime.* Timing is added as a control variable. There appear to be times of "hot" markets which are periods of time where investors have an over-optimistic view on the value of the young growth companies. This optimism is used by entrepreneurs to gain better access to capital, therefore these periods of hot market are characterized by increasing IPO activity. To control for the influence of size on market value, total assets are included. Analyses shows that the number of new drugs in a biotech firm's research pipeline and the number of times the published papers of a firm's research team is cited have a positive relationship with firm performance.

Marqués and Simon (2006) investigated the causal relationship between knowledge management practices and firm performance by an empirical study on 222 Spanish firms in the biotechnology and telecommunications industries. They employ the competence-based view of the firm and focuses on the importance of knowledge management as a sustainable competitive advantage. Tests for dimensionality, reliability and validity are done. The reliability parameters used are not very high. According to Marqués and Simon this is due to the fact that there are other variables that affect firm performance that are not included in the model. They do conclude that there is a strong and positive relationship between knowledge management practices and firm performance.

Wiklund and Shepherd (2003) add the term entrepreneurial orientation. They empirically tested the relationship between knowledge-based resources, firm performance and entrepreneurial orientation based on a sample of 384 Swedisch SME's. The dependent variable "firm performance" is an index composed of 10 dimensions: sales growth, revenue growth, growth of the number of employees, net profit margin, product/service innovation, process innovation, adoption of new technology, product/service quality, product/service variety and customer satisfaction. Environmental munificence, heterogeneity, past performance, firm age and industry effects are controlled for. They conclude that knowledge-based resources are positive related to firm performance and entrepreneurial orientation enhances this relationship.
Kalling (2003) makes a distinction between three instances of knowledge namely knowledge development, utilization and capitalization. Three knowledge ventures within a European manufacturing multinational company were used. This empirical study indicates that though knowledge development is a frequent phenomenon, the utilization of it is not so widespread. Even when knowledge is utilized, it may not always result in an improvement in profitability. The research of Kalling questions the frequently stated link between knowledge management and firm performance and indicates that specialists' knowledge is coupled with generalist business overview, and that general managers need to be active in managing the entire business, not just those activities that are directly affected by the knowledge.

3. Research design

The existing literature clearly indicates that there is a link between knowledge management and innovation performance. However, there are multiple requirements for knowledge management to have an effective influence on innovation. As indicated before we specifically focus on the management of knowledge and the techniques that firms use to proceed this. We would like to integrate the different aspects of knowledge management reaching from firm policy and datasets over the information sharing between employees to the use of external sources for acquiring knowledge. If the difference phases from knowledge creation to knowledge application, where most literature related to knowledge management is about, are successfully managed, this will lead to improvements in innovation performance. As indicated before, innovation performance will be subdivided into product and process.

We predict that the introduction of a codified knowledge management policy, the database and manuals will have a positive effect on both product and process innovation. These techniques make knowledge easier available and more structured which can only improve performance.

We do expect a different effect of the employee stimuli and the external knowledge on product versus process innovation.

For the introduction of new products, external knowledge will be of significant large importance. New products are introduced to satisfy consumer needs. So to start with, these consumers needs already need to be identified. External knowledge is of importance here. Additionally, there is a high possibility that the resources or capabilities needed to produce a product satisfying these needs are not yet available in the firm. Therefore it is useful to generate knowledge from external sources.

On the other hand, to introduce a process innovation in terms of a cost reduction, we expect the knowledge of employees to be of larger importance. Process innovation relates innovation to renew or improve the existing products in the firm. It is much more dependent on the resources and capabilities already available in the firm. Here the aspect of knowledge embedded in the personnel becomes important. It is easier for internal people to detect existing problems because they are confronted with it day in day out. It would take external experts a much longer time to first observe and process everything and then to come up with an improvement.

Data sources, variables and descriptive statistics

The data is taken from the Belgian Community Innovation Survey (CIS) 2007. The CIS is a European-wide, harmonized data collection on innovation, and it follows the guidelines of the Oslo Manual (Eurostat/OECD, 2005). The data is cross-sectional and refer to the years 2004-2006. The industries covered are the manufacturing sector, trade, transport and business services, such as ICT, technical services and other.

The main question of this analysis is whether firms that employ certain knowledge management techniques perform better in terms of innovation (output). The final sample includes 1474 firm observations.

Three different indicators are used to measure firm performance. NEWPROD and TURNMAR measure the outcome of product innovation and REDUC measures the outcome of process innovation. NEWPROD indicates if a firm has introduced a new

product or service to the market or/and introduced a product or service new to the firm. While NEWPROD also include product/service imitation, TURNMAR is an indicator variable that refers to the subset of product/service innovators that introduced at least one market novelty between 2004 and 2006. REDUC indicates whether process innovations led to a decrease in average unit cost.

As further test, we also take the extent of product and process innovation into account. NEWPROD% measures the share of new product sales in total sales of the firm in the year 2006. Similarly, TURNMAR% measures sales share of market novelties. Finally REDUC% measures the relative reduction in the average unit costs as a consequence of process innovation.

As already indicated before, we employ a new concept of measuring knowledge management. Firms were requested to indicate the usage of three different knowledge management practices. KMEMPL focuses on the personnel side and indicates whether the company applies stimuli for active knowledge sharing among employees. KMPOLUP indicates whether there is a codified knowledge management policy in the company or if there is a regular updating and maintaining of internal databases or manuals related to the practices, learned lessons and advice from experts. The engagement of a firm in acquiring external knowledge is indicated by KMEXRC. This defines if there are specific measures to detect and capture knowledge from outside the company or if there is a policy to involve external experts from universities, research institutes or other companies in project groups if necessary.

While we are mainly interested in the relationship between the knowledge management practices and the different dimensions of innovation performance, we control for a number of other factors in our regression analyzes.

A crucial innovation input is research and development (R&D). We measure a firm's R&D intensity as R&D divided by total sales (in the previous period). Furthermore, we include whether a firm makes use of formal intellectual property protection, as it may increase performance due to the blocking of imitation (at least to a certain extent). PROPAT and PROTM are dummies indicating whether a company has filed a patent application or a trademark, respectively. Furthermore, we control for market structure by including two dummy variables. The companies were asked to indicate how many competitors are active on their main product market. The variable HIGHCMPT is a dummy indicating more than 15 competitors. MEDCMPT indicates

an oligopolistic market structure of four to 15 competitors. The base category refers to a tight oligopoly of less than four competitors.

Finally, we control for (lagged) firm size, as larger firms may realize economies of scope in their innovation process as they typically have multiple projects. LOGEMP stands for employment in 2004. We also control for the age of the firm (LOGAGE), and whether a firm is associated with a group of firms. The latter may facilitate access to markets, and thus higher innovation. Twelve industry dummies capture unobserved heterogeneity across sectors which is not captured by any of the aforementioned variables.

Table 1: Descriptive statistics (1474 observations)

Variable	Mean	Std. Dev.	Min	Max
NEWPROD	0.393	0.489	0	1
TURNMAR	0.304	0.460	0	1
REDUC	0.249	0.432	0	1
NEWPROD%	0.108	0.214	0	1
TURNMAR%	0.055	0.145	0	1
REDUC%	1.758	5.20	0	60
KMEMPL	0.400	0.490	0	1
KMPOLUP	0.454	0.498	0	1
KMEXRC	0.397	0.489	0	1
LOGEMP	-3.083	1.375	-6.907	1.702
LNAGE	3.098	0.903	0	5.560
PROPAT	0.124	0.330	0	1
PROTM	0.145	0.352	0	1
RD	0.017	0.055	0	0.5
GP	0.524	0.499	0	1
MEDCMPT	0.425	0.494	0	1
HIGHCMPT	0.249	0.432	0	1

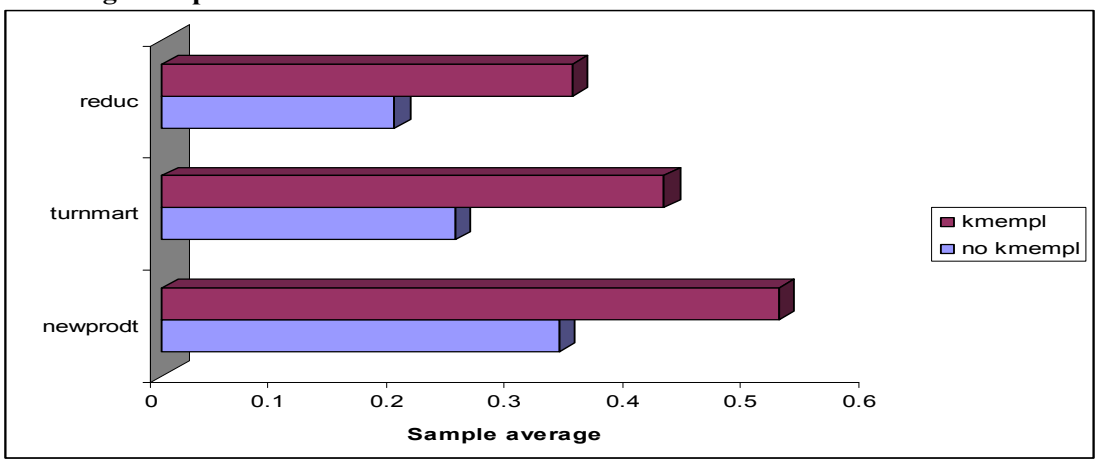
Note: 12 industry dummies not presented.

On average 11 percent of the observed companies indicate the have introduced a product or service which was new to the market or to the firm, and 6 percent of firms indicated having market novelties. 25 percent of the observed firms indicated unit cost reductions due to process innovations.

40 percent of the firms have incentive systems for employees in place, and about 45 percent indicate to maintain any form of codified knowledge management policy, and also 40 percent use a form of external knowledge via resources or experts.

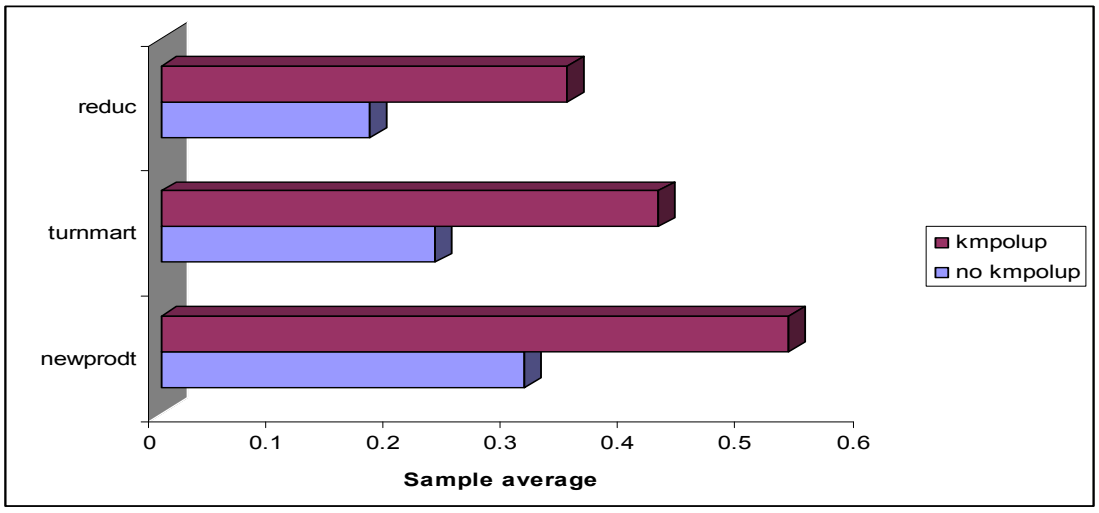
As a first step of our analysis, we simply compare the average innovation performance of firms that have a certain knowledge management system in place with other firms that do not have such system.

Fig. 1: The impact of stimuli for employees to share knowledge on cost reduction, new knowledge and products new to the market



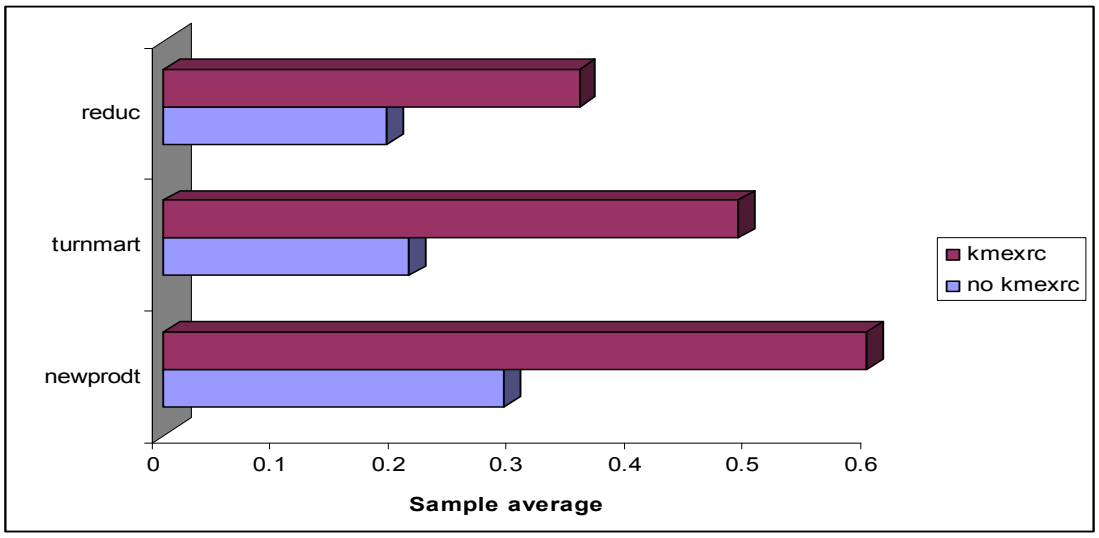
On average, firms that use stimuli for employees to share knowledge will have more new products, products new to the market and cost reduction. The use of stimuli is most effective for reducing costs in the firm, on average 35 percent of the firms that engage in stimuli for employees to share knowledge will reduce costs. The use of stimuli will lead to the introduction of new products to the market or to the firm in 52 percent of the cases.

Fig. 2: The impact of a codified knowledge management policy on cost reduction, new knowledge and products new to the market



Firms using codified knowledge management policies will have more cost reduction, new products and products new to the market. The introduction of a codified knowledge management policy has the biggest absolute effect on the probability of a new product introduction.

Fig. 3: The impact of resources to generate external knowledge or a policy to attract external experts on cost reduction, new knowledge and products new to the market



The sourcing from knowledge external to the firm has on average a positive effect on cost reduction, products new to the market and new products relative to companies that do not source external knowledge.

Overall, it can be concluded that the three different knowledge management techniques positively influence product and process innovation in the firm. We observe little variation of the influence of the different techniques on the innovation measures e.g. 15 percent of the firms using one of the three knowledge management techniques will introduce new products relative to only 8 percent of the firms which do not use one of the knowledge management techniques. However, it remains to be investigated whether these results hold in a multivariate analysis.

4. Estimation results

For the multivariate analysis, we employ standard microeconometric techniques. First, we perform Probit regressions on the probability to have new product sales, sales with market novelties, and unit cost reductions due to the implementation of new processes, respectively. Subsequently, we report Tobit estimates on the percentage figures of the three variables. We treat the variables as left-censored at zero for firms

that did not report positive values for the innovation outcomes. As heteroscedasticity tests indicated a violation of homoscedasticity in the Tobit models – which would lead to inconsistent coefficient estimates – we report results from heteroscedastic Tobit models where we model the variance as groupwise multiplicative. The heteroscedasticity term includes size class dummies (based on employment) and the twelve industry dummies. The homoscedastic tobit models are relegated to the appendix just for completeness. Although homoscedasticity is rejected, the results do not considerably differ between the homoscedastic and heteroscedastic specification.

Table 2 summarizes the results for the probit regressions on the three dependent variables. When a firm raises its external knowledge capturing or its cooperation with external experts, this firm will have a higher probability of introducing new products. The codified knowledge management policy also improve the probability of the introduction of new products. When a firm codifies tacit knowledge, this positively affects firms' new product introduction. More specifically for the introduction of a product new to the market, this codification is not significant, only external knowledge by means of sources or experts are significant. For none of the two product innovation indicators, the estimated coefficient of incentives for employees to share knowledge is significant. This is intuitive as the bench-level interaction of employees will mainly lead to improved production processes, which is reflected in the highly significant positive effect on unit cost reductions. However, new product introduction are possibly more related to the management or careful market screening and knowledge seeking outside the firm's boundaries.

As expected firm size is positively related to innovation performance, which indicated the utilization of economies of scope in larger firms. The R&D intensity also has the expected positive effect on innovation performance. A firm actively pursuing an intellectual property right policy will also achieve a higher innovation performance. The effect is more pronounced for the new product and market novelty regressions than for the process innovations, though.

The twelve industry dummies are jointly significantly different from zero, but the other covariates, i.e. age, the group dummy and market structure are basically insignificant in all regressions.

Table 3: Probit regressions

Variable	NEWPROD	TURNMAR	REDUC
KMEMPL	0.035	0.111	0.206**
	(-0.089)	(0.09)	(0.09)
KMPOLUP	0.217**	0.118	0.317***
	(0.089)	(0.09)	(0.092)
KMEXRC	0.426***	0.417***	0.12
	(0.086)	(0.087)	(0.089)
LOGEMP	0.145***	0.077**	0.149***
	(0.034)	(0.034)	(0.035)
RD	5.559***	3.945***	0.955
	(0.898)	(0.77)	(0.727)
LNAGE	-0.009	0.015	-0.016
	(0.045)	(0.046)	(0.047)
PROPAT	0.444***	0.586***	0.217*
	(0.129)	(0.121)	(0.125)
PROTM	0.564***	0.489***	0.229**
	(0.113)	(0.109)	(0.111)
MEDCMPT	-0.016	-0.033	0.042
	(0.089)	(0.091)	(0.093)
HIGHCMPT	-0.164	-0.188*	-0.139
	(0.103)	(0.106)	(0.108)
GP	-0.078	-0.129	0.02
	(0.084)	(0.087)	(0.088)
INTERCEPT	-0.02	-0.598**	-0.274
	(0.255)	(0.261)	(0.263)
Log-Likelihood			
Mc-Fadden R^2			

Note: All regressions include 12 industry dummies not reported here.
*** (**, *) indicate a significance level of 1% (5%, 10%).

Table 3 presents the results of the heteroscedastic Tobit regressions. The results are remarkably robust when compared to the Probit regressions. Basically all previous results are also obtained when we consider the percentage variables (sales shares or cost reductions in percent) instead of the dummy variables as the dependent variables.

Table 4: Heteroskedastic Tobit regressions

Variable	NEWPROD%	TURNMAR%	REDUC%
KMEMPL	0.018	0.021	2.591**
	(0.024)	(0.018)	(1.14)
KMPOLUP	0.054**	0.024	2.5**
	(0.024)	(0.018)	(1.178)
KMEXRC	0.097***	0.068***	-0.046
	(0.024)	(0.018)	(1.181)
LOGEMP	0.038***	0.02***	2.171***
	(0.009)	(0.007)	(0.487)
RD	1.981***	1.664***	22.819*
	(0.217)	(0.171)	(13.145)
LNAGE	-0.02*	-0.013	-0.034

	(0.012)	(0.009)	(0.538)
PROPAT	0.085***	0.085***	1.479
	(0.031)	(0.022)	(1.466)
PROTM	0.114***	0.072***	2.264*
	(0.028)	(0.02)	(1.301)
MEDCMPT	0.029	0.015	2.72**
	(0.025)	(0.019)	(1.212)
HIGHCMPT	-0.03	-0.031	-0.277
	(0.029)	(0.022)	(1.47)
GP	-0.034	-0.037**	1.565
	(0.025)	(0.018)	(1.294)
INTERCEPT	0.03	-0.045	-4.356
	(0.065)	(0.05)	(3.045)
Log-Likelihood			
Mc-Fadden R^2			

Note: The variables in the analysis also include 12 industry dummies not reported here

5. Conclusion

In conclusion, this study shows that knowledge management techniques have a positive effect on the innovative performance of a firm. A codified knowledge management policy is effective for the introduction of new products or engagement in cost reductions. However, this study shows that it makes sense for firms that engage in innovation to adjust their techniques to perform knowledge management to the kind of innovation, product versus process. Certain knowledge management techniques are more effective to increase innovative performance. More specifically, if a firm wants to reduce costs, it is more effective to invest in stimuli for employees to share knowledge. Contrary if a firm aims at introducing new products it would be more be more beneficial to source external knowledge. A codified knowledge management policy does not appear significant if a firm wants to specifically aim at the introduction of products new to the market relative to the overall introduction of new products. This study indicates that it is important for a firm to carefully select the techniques of knowledge management in function of the kind of technical innovation it wants to proceed.

In order to complement our findings it would be interesting to look at the influence of the knowledge management techniques on overall firm performance. The management of knowledge is part of the broader organizational strategy. It does not limit its influence to innovation performance. Additionally, knowledge management also occurs in companies which do not involve in any form of technological innovations. Thus, to capture the whole effect of the knowledge management

techniques it would be interesting to analyse the effect on performance measures such as sales growth or profitability. Further studies are also possible linking knowledge management and innovation to firm performance. Earlier research already studied the influence of innovation on firm performance frequently. It would be interesting to investigate whether firms that involve in technological innovation stimulated by knowledge management techniques perform better than firms that engage in technological innovation but do not use knowledge management techniques for this kind of innovation.

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Appendix

Table 5: Homoskedastic tobit

Variable	NEWPROD%	TURNMAR%	REDUC%
KMEMPL	0.025	0.045**	3.454**
	(0.027)	(0.022)	(1.472)
KMPOLUP	0.062**	0.03	3.603**
	(0.027)	(0.022)	(1.494)
KMEXRC	0.097***	0.069***	0.065
	(0.027)	(0.022)	(1.443)
LOGEMP	0.021**	0.002	1.248**
	(0.01)	(0.008)	(0.555)
RD	1.578***	1.325***	22.682**
	(0.196)	(0.153)	(11.439)
LNAGE	-0.017	-0.008	-0.101
	(0.014)	(0.011)	(0.769)
PROPAT	0.125***	0.121***	1.711
	(0.035)	(0.027)	(2.03)
PROTM	0.147***	0.12***	3.425*
	(0.032)	(0.025)	(1.792)
MEDCMPT	-0.001	-0.011	0.162
	(0.028)	(0.022)	(1.504)
HIGHCMPT	-0.055*	-0.064**	-2.967
	(0.033)	(0.027)	(1.781)
GP	-0.024	-0.043**	1.704
	(0.027)	(0.022)	(1.446)
INTERCEPT	-0.095	-0.202	-11.66
	(0.079)	(0.066)	(4.4)
Log-Likelihood			
McFadden R2			

Note: The variables in the analysis also include 12 industry dummies not reported here