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External knowledge sourcing and innovation performance: The role of managerial practices.

Ana García Granero
INGENIO (CSIC-UPV) Universitat Politècnica de València

angargr2@ingenio.upv.es

Jaider Vega-Jurado
INGENIO (CSIC-UPV) Universitat Politècnica de València

javega@ingenio.upv.es

Abstract

EXTERNAL KNOWLEDGE SOURCING AND INNOVATION PERFORMANCE: THE ROLE OF MANAGERIAL PRACTICES.

Ana García Granero, INGENIO (CSIC-UPV) Universitat Politècnica de València; (2010-2014); angargr2@ingenio.upv.es.

Current theories on innovation hold that individual firms are seldom capable of innovating independently and that the search for new product ideas goes beyond the firm"s boundaries to other firms or institutions. Along these lines, numerous academic studies have examined the issues pertaining to the leverage and exploitation of external knowledge (Chesbrough 2003; Cassiman and Veugelers 2006). These studies have advanced firm"s internal resources as relevant in order to take advantage of external knowledge sourcing. This idea is reminiscent of the absorptive capacity theory (Cohen & Levinthal 1990), which highlights technological and organizational dimensions, as important determinants of the firm"s ability to acquire, integrate and exploit external knowledge. However, most of the empirical studies carried out so far have limited their research to technological resources (mainly R&D efforts), neglecting the role played by the firm"s internal organization in the exploitation of external knowledge.

Our aim is to contribute theoretically and empirically to the mentioned gap, by analyzing the managerial practices that

influence the firm''s ability to leverage and exploit external knowledge for innovations. In particular, we center our analysis in knowledge sharing and formalization-based mechanisms (Jansen et al. 2006) and knowledge incentives (Foss et al. 2010) as relevant practices, which can influence the results based on the exploitation of external knowledge. Furthermore, we analyze the differential effects in the results when considering the distinct types of knowledge involved. In particular, we discriminate between scientific and industrial knowledge, the former being characteristic of agents such as universities and research centers, and the latter typical of agents related to the firm''s value chain.

In this paper, we present preliminary results from a 2011 survey focused on the firms belonging to the Spanish ceramic tile industry. Most of these firms are concentrated in an industrial district and are classified as SMEs. The response rate was of 72%, reflecting a very high sample according to previous respondent patters (Alegre and Chiva 2008). A first approximation to the phenomenon reveals that mechanisms enhancing knowledge sharing are highly relevant in integrating and applying external knowledge to innovation results, while formalization-based mechanisms and knowledge incentives seem detrimental for this purpose. Moreover, it is also highlighted that results are contingent on the type of knowledge absorbed and the nature of the innovation involved.

In short, we have discussed the role of management in the leverage and ultimate exploitation of external knowledge sourcing. In this sense, this study contributes to the research in external knowledge sourcing, innovation, and to some extent, absorptive capacity and organizational learning literatures. In this sense, we show that certain managerial practices are important facilitators of external knowledge exploitation. The necessity of integrating the inner firm''s processes into the analysis becomes clear in order to achieve a more holistic approach.

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EXTERNAL KNOWLEDGE SOURCING AND INNOVATION PERFORMANCE: THE ROLE OF MANAGERIAL PRACTICES.

Ana García Granero*
Institute of Innovation and Knowledge Management
INGENIO (CSIC-UPV) Universitat Politècnica de València

angargr2@ingenio.upv.es

Jaider Vega-Jurado
Institute of Innovation and Knowledge Management
INGENIO (CSIC-UPV) Universitat Politècnica de València

javega@ingenio.upv.es

Abstract

In this paper, we argue that the ability of a firm to transform external knowledge into commercial success goes beyond the firms' technological capabilities. Thus, we underscore the role played by managerial practices (related with knowledge sharing, formalization and incentives) in the leveraging and utilization of external knowledge. We further consider that the effectiveness of external knowledge exploitation can be contingent on the types of external sources (scientific and industrial partners) and on the degree of novelty in innovations (imitative and new-to-the-market innovations). The research draws on survey data from the Spanish Ceramic Tile Industry and the main results suggest that firms adopting knowledge sharing mechanisms are more likely to attain better results in exploiting external scientific knowledge. On the contrary, formalization-based mechanisms tend to exert a detrimental effect on the exploitation of external scientific knowledge. Knowledge incentives are non significant in the case of scientific agents and negative for industrial agents.

Keywords: External knowledge sourcing, scientific and industrial partnering, managerial practices, product innovation.

INTRODUCTION

A broad range of approaches have highlighted the necessity of studying innovation as a phenomenon taking place beyond the boundaries of the firm. Evolutionary (Lundvall 1992; Breschi & Malerba 1997) and innovation network theorists (Haakansson 1987; Baptista & Swann 1998) underscore the increasingly importance of interactions between organizations and external agents in the achievement of innovative results. Open innovation theorists have also analyzed how firms look toward the exterior in order to leverage useful knowledge when pursuing innovations and have even emphasized that external knowledge has gained importance in contrast to more traditional knowledge created through internal research and development (Chesbrough 2003; Laursen & Salter 2006).

Following this line of inquiry several works have analyzed the effect of external knowledge sourcing on innovation by taking into account the conditioning effect of internal capabilities. Particularly, absorptive capacity theory (Cohen & Levinthal 1990) has been central in explaining the role played by technological and organizational capabilities when taking advantage of external sources. However, despite the number of empirical studies carried out on this topic, the majority has focused on technological capabilities (mainly regarding to R&D activities) and has said little about the role of firm's internal organization in this process (For an exception see Van Den Bosch et al. 1999; Jansen et al. 2005; Foss et al. 2010). Our aim is to contribute into this area of research and further consider that the effectiveness of external knowledge exploitation can be contingent on the characteristics of external sources and on the degree of novelty of innovations.

On the one hand, we try to extend the existing research by undertaking a more grained approach, which considers different external agents. According to the existent literature external agents can be more science or more industrial knowledge-based, resulting in divergent learning patterns and possible differing innovation results. In this line of thinking we argue that partnering with scientific agents or on the contrary, interacting with industrial agents could demand specific managerial practices in order to successfully exploit the knowledge acquired.

On the other hand, we also integrate into the analysis the degree of novelty within innovation results. Few empirical studies have eventually discriminated innovation in this sense (see Romijn & Albaladejo 2002; Amara & Landry 2005; Reichstein & A. Salter 2006). We consider that it is highly relevant to understand the determinants of minor and major innovations. In particular, we consider imitative and new-to-the-market innovation types, the former being innovations already exploited by competitors and the latter, innovations first introduced in the market by the firm (Leiponen and Helfat 2010).

In this respect we enrich the theoretical discussion involving the effect of managerial practices in the effectiveness of external knowledge exploitation and also, provide empirical evidence based on the Spanish Ceramic Tile Industry. This sector is of particular interest because it tends to be geographically concentrated in industrial districts and most of the firms are considered to be small and medium-sized firms. These characteristics provide our analysis with a way above average number of agreements between external agents and the firm. In addition, SMEs have been said to be more dependent on external knowledge as a source of rejuvenation (Lichtenthaler and Ernst 2009).

The paper is organized as follows: Section 2 presents the theoretical framework underlying this investigation and the proposed hypotheses. Section 3 establishes the basis of the empirical

investigation, justifying the sample chosen and the measurements that have been used. Section 4 describes the analysis undertaken and presents the results. Section 5 puts forward the main conclusions extracted from the study and finally, section 6 presents the limitations of the study and possibilities for further research.

THEORETICAL AND EMPIRICAL BACKGROUND

The absorptive capacity literature, though mostly from the theoretical point of view has been the main theory giving insights into the importance of the firm's organizational dimension in the exploitation of external knowledge. So even though Cohen and Levinthal's analytical model (1990) exclusively focused on research and development activities, the crux of their theoretical framework lied on the organizational mechanisms underlying the transfer of external knowledge. In this sense certain managerial practices were underscored as fundamental in the ultimate exploitation of external knowledge[1]. In the same line, Zahra & George (2002) suggested that firms couldn't exploit external knowledge if they had not previously acquired and integrated this knowledge into their organizational processes.

However, the belief that acquisition of knowledge does not necessarily imply the capacity for its transformation and exploitation has not been reflected in empirical studies. Analyses that have considered internal firm's capabilities as necessary when taking advantage of external knowledge have mainly focused on knowledge content (primarily technological knowledge), neglecting the important role of managerial practices in this process (see Miotti & Sachwald 2003; Belderbos et al. 2004; Faems et al. 2005; Arranz 2008; Tsai 2009). Even in some of these studies, the absence of these factors has been advanced as a limitation. For instance, Faems et al. (2005) argues that the amount of unexplained variance in their model could be related to the absence of organizational structures that substantially influence how and to what extent organizations innovate.

To the best of our knowledge, only few studies have approximated empirically the role of organizational factors in the process of leveraging and exploiting external knowledge (Van Den Bosch et al. 1999; Jansen et al. 2005; Foss et al. 2010). Van den Bosch et al. (1999) establish a framework in which they posit that the level of prior related knowledge and organizational mechanisms are the main antecedents of the acquisition and exploitation of external knowledge proving it in two longitudinal case studies of traditional publishing firms moving into a turbulent environment of an emerging multimedia industrial complex. In addition, Jansen et al. (2005) test a similar model on an empirical study concerning a multi-unit financial services firm. Finally, Foss et al. (2010) also study certain managerial practices and its effect on the exploitation of external knowledge but in this case the focus lies on one specific type of external source, that is to say, clients and users. However these studies have said little about the effect that managerial practices can exert on the exploitation of different kinds of external knowledge sources and its effect on different types of innovations.

[1]In Cohen and Levinthal's (1990) own words: "Absorptive capacity refers not only to the acquisition or assimilation of information by an organization but also to the organization's ability to exploit it. Therefore, an organization's absorptive capacity does not depend on the organization's direct interface with the external environment. It also depends on transfers of knowledge across and within subunits that may be quite removed from the original point of entry."(p.131)

1. Different types of external sources and innovation results

In the search for knowledge available beyond the internal organizational boundaries, firms have the choice of reaching multiple actors that can be determinant in their innovation results[2]. External partners primarily include suppliers, customers, lead users, universities, research centers and industry competitors; and all of them have been advanced as relevant in the search for innovative ideas (Miotti & Sachwald 2003; Fey & Birkinshaw 2005). However, when analyzing in detail each agent salient differences are reflected[3]. In this sense, Miotti and Sachwald (2003) argue that suppliers and clients are agents that play a pivot role in the incremental day-to-day innovation process, meanwhile universities focus on the most generic or basic end of the R&D complex. Faems et al. (2005) describe suppliers and customers as "exploitation oriented", while universities as sources more "explorative-oriented" in nature. Even Cohen and Levinthal (1990) distinguished between external sources by citing universities as organizations that produce basic research, as opposed to input suppliers, which usually possess knowledge targeted to firms needs.

The implications of different partnering on learning and innovation have been advanced by literatures such as organizational learning and absorptive capacity. Organizational learning approaches have recognized that different knowledge characteristics can provoke either more exploitative or more explorative learning patterns (Lavie & Rosenkopf 2006). For instance, in the study of Gilsing & Nooteboom (2006) the collaboration between biotechnology firms and academic institutes is considered to involve the transmission of scientific knowledge, thus generating explorative learning oriented towards the development of new technologies. In other articles, agents such as customers and suppliers have been characterized as optimizers of existing core competences (Brown & Eisenhardt 1995; Faems et al. 2005). Absorptive capacity theory studies (Cohen and Levinthal 1990[4]; Mangematim and Nesta 1990, Vega-Jurado et al. 2008; Schmidt 2010) have mainly argued that when outside knowledge is less targeted to the firm's own particular needs and concerns, the difficulty of learning is higher, thus firms' own R&D becomes more important in permitting to recognize the value of knowledge, assimilate and exploit it.

[2] We only consider active knowledge sources, however according to the Oslo's Manual (OCDE/Eurostat 2005) passive knowledge sources can also be relevant in firm's innovation processes.

[3] When studying the different external sources of knowledge used by firms, scholars have based their analysis on basis to two criterions: The type of knowledge embedded in each source and transmitted to the firm plus the nature of the relationship existent between the source and the firm. For instance, from the UIR perspective, the study of the barriers or obstacles encountered in the collaboration between universities and firms, underlines two main reasons: The first reason is related with the nature of the exchanged knowledge, in the case of universities, scientific knowledge. The second reason is related with the problems of cultural clashes, bureaucratic inflexibility and other factors associated with the different institutional norms governing public and private knowledge (Dasgupta & David 1994; Knudsen 2007; Bruneel et al. 2010).

[4] Cohen and Levinthal (1990) words "although it is difficult to specify a priory all the knowledge characteristics affecting the ease of learning they would include the complexity of the knowledge to be assimilated and the degree to which the outside knowledge is targeted to the firms needs and concerns of the firm" (p.140)

Building on these literatures we argue that understanding the nature of the knowledge being absorbed has critical strategic implications concerning the need of different learning types, which ultimately have an effect on the firm's innovation performance. However, only few studies on external knowledge sourcing have considered distinct degrees of novelty in innovation results (Amara & Landry 2005; Vega-Jurado et al. 2008). In their study of manufacturing firms Amara et al. (2005) conclude that thefirms developing innovations with higher degrees of novelty (major innovations) tend to rely more frequently on research sources (such as universities and research laboratories) than the firms developing minor innovations, which usually rely on market sources. Romijn & Albu (2001) lead to similar conclusions but in the context of small high technology firms. Furthermore, Christensen & Overdorf (2000) argued that suppliers and customers would not be adequate partners when looking for projects of a more novel nature. So, following these studies we propose to study the following hypothesis:

H1: Interacting with scientific agents has positive impacts on innovation results, especially when innovations are new to the market (major innovations).

H2: Interacting with industrial agents has positive impacts on innovation results, especially when innovations are imitative (minor innovations).

2. Managerial practices

Managerial practices have the virtue of conditioning the process that enables external knowledge to be commercially exploited. These practices have been advanced as essential for the generation and the development of firm's capabilities related with the capacity of synthesizing and applying acquired and existent knowledge. In this line of thought our called managerial practices have been associated with terms such as combinative (Van Den Bosch et al. 1999; Jansen et al. 2005) and integrative capabilities (Helfat and Campo-Rembado 2010).

Within these managerial practices we aim to study the practices related with coordination mechanisms (Jansen et al. 2006) and knowledge incentives (Foss et al. 2010). Knowledge coordination mechanisms direct attention and group together key resources and interdependent functions needed to develop innovations (Jansen et al. 2006). Concretely, we will study two generic types of knowledge coordination mechanisms: knowledge sharing mechanisms and formalization-based mechanisms. Knowledge sharing-based mechanisms bring together different sources of expertise and increase lateral interaction between areas of knowledge (Jansen et al. 2005), meanwhile formalization-based mechanisms describe the degree to which behaviors are programmed by formal explicit rules (Khandwalla 1977). Furthermore, we will study knowledge incentives directed to facilitate the creation of new ideas and the improvement of skills and knowledge among employees. This type of knowledge incentives relates mainly to the process of searching for knowledge (Foss et al. 2010).

The benefits' involving the share of knowledge between employees has been repeatedly emphasized in the literature. For instance, several authors have pointed to the importance of better internal communication in the lowering of barriers towards the integration and exploitation of external knowledge (Van Den Bosch et al. 1999; Zahra & George 2002)[5].

[5] Fewer studies have advanced that an excessive socialization of external knowledge could provoke the dispersion of novel external knowledge making the synthesis with the existing knowledge more difficult (Pérez-Luño & Valle-Cabrera 2010; Franco et al. 2011). However, we consider these studies less important.

Notwithstanding, formalization appears as a more controversial theme in the literature. In the one hand, it acts as a facilitator of knowledge exchange due to its efficacy in setting clear procedures, thus eliminating the need for further communication and coordination among subunits and positions (Van den Bosch et al. 1999), and in the other hand; it inhibits knowledge flows because of the creation of rigidities within the organization. Regarding knowledge incentives, it is argued that an active search for knowledge is positively related with the sharing of knowledge within the organization. For this reason the flows of information within the organization can be enhanced (Foss et al. 2010)[6]. In the next lines we will argue that the effects of these managerial practices on the exploitation of external knowledge will be contingent on the type of knowledge.

2.1. Knowledge coordination mechanisms

2.1.1. Related with knowledge sharing:

The positive effect of these mechanisms in the exploitation of external knowledge is enhanced when considering scientific knowledge. It is argued that when knowledge is scientific, the capacity of the firm for its absorption will be more dependent on its R&D efforts (Cohen & Levinthal 1990; Mangematin & Nesta 1999). Following this argument, when the partners' knowledge is more distant from the firms' knowledge base, more targeted mechanisms (such as knowledge sharing mechanisms) also play a role in successfully integrating it within the organizations different units. However, in the case of industrial knowledge these mechanisms could result ineffective because usually knowledge from firms own industry can be easily understood by the firm's employees and the application of mechanisms oriented to knowledge exchange could mean additional costs (Vega-Jurado et al. 2008; Schmidt 2010).

H3: Knowledge-sharing mechanisms are positive moderators of scientific knowledge and innovation.

H4: Knowledge-sharing mechanisms have no moderating effect on the relationship between industrial knowledge and innovation.

2.1.2. Related with formalization:

As exposed before formalization-based mechanisms do not present so many consensuses within the literature. One the one hand, it is argued that in the case of scientific agents, formalization enhances the integration of knowledge because it reduces the necessity of coordination (Van Den Bosch et al. 1999; Vega-Jurado et al. 2008). On the other hand, other studies defend that in this case formalization could difficult the integration of knowledge by creating rigid structures, which inhibits the integration of knowledge (Jansen 2005)[7].

Moreover, formalization based mechanisms are especially important because they have the power of codifying knowledge and in this sense, by making knowledge explicit its transfer becomes more efficient (Kogut & Zander 1992; Jansen et al. 2006). However, it is argued that

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[6] Innovation depends to a large extend on the creativity residing on the organization's employees. However, the benefits of implementing this design policy could be insufficient when the organization incurs in high costs (Baumann & Stieglitz 2008).

[7] This was their argument on their theoretical framework, however the empirical analysis found a positive effect when considering the effect of formalization on the exploitation of external knowledge.

formalization can difficult the integration of knowledge, especially in the case of industrial agents because of possible knowledge spillovers (Fey & Birkinshaw 2005).

H5a: Formalization-based mechanisms are positive moderators of scientific knowledge and innovation.

H5b: Formalization-based mechanisms are negative moderators of scientific knowledge and innovation.

H6a: Formalization-based mechanisms are positive moderators of industrial knowledge and innovation.

H6b: Formalization-based mechanisms are negative moderators of industrial knowledge and innovation.

2.2. Knowledge incentives

To the best of our knowledge, research on incentives and its effect on the exploitation of external knowledge is not extent. In the study of Foss et al. (2010) knowledge incentives result important moderators between the acquisition of user (and clients) knowledge and innovation. Furthermore, in the analysis of Schmidt (2010) the author disaggregates external knowledge into different types and results show that regardless of the kind of knowledge absorbed the stimulation of employees to be involved in the innovation process is essential in the exploitation of external knowledge.

H7: Knowledge incentives will have a positive moderating impact on scientific agents and innovations.

H8: Knowledge incentives will have a positive moderating impact on industrial agents and innovations.

RESEARCH METHODOLOGY

In this research we conducted a 2011 survey focused on the firms belonging to the Spanish ceramic tile industry[8]. Spanish ceramic tile firms play a relevant role in the international ceramic industry. Concretely, exports rates between 15 and 18% of international commerce have placed Spain as the third country worldwide in the sector (ASCER, 2011)[9].

Moreover, it is worth understanding the specific characteristics the sector presents. First, the ceramic tile industry in Spain tends to be geographically concentrated in industrial districts. In particular, this tied network of actors is located in the province of Castellón[10], where 81% of the firms in the sector are located and approximately 94% of the Spanish production in the sector takes place (ASCER, 2011). Second, most of the firms are considered to be SMEs.

The important number of firms concentrated in Castellón provides the empirical study with enough firms' external linkages, which enables us to answer our research question concerning the different actors involved in the knowledge sourcing process. In the case of Castellón there

[8] Ceramic tiles are used as an intermediate product by construction firms and as a consumer good in the restoration of residential accommodation (Flor & Oltra 2004).

[9] ASCER is the Spanish association of ceramic tile producers.

[10] Especially in the area delimited by the north of Alcora and Borriol, the west of Onda, the south of Nules and the east of Castellón de la Plana.

is a close link between firms and the following research institutes and universities: Technological Institute of Ceramics in Castellón, the Jaume I University, the University of Valencia and the Polytechnic University of Valencia among others. These universities in the sector mainly generate relevant knowledge, skills and techniques that emerge from academic chemistry research. Moreover, the ceramic tile suppliers, such as manufacturers of equipment and frits and glazes producers, are also found in the province (Alegre et al. 2004).

In general innovative behavior among Spanish ceramic tile producers is significant (Alegre & Chiva 2008). Features of the ceramic tile industry suggest it belongs to the supplier- dominated trajectory of Pavitt's taxonomy (Pavitt 1984). Suppliers of equipment have been essential in the processes involving the production of ceramic tiles, reflected by the huge investments made by ceramic manufacturers in equipment during the last years (Flor & Oltra 2004). Moreover, producers of frits and glazes framed in the chemistry industry represent a fundamental material supplier for ceramic manufacturing firms. This is the reason why when considering the industrial external agents involved in the process we focused on suppliers.

1. Sample selection

Our target population comprises around 229 ceramic tile manufacturers in Spain[11] and the questionnaire was sent to all of the population. Thank you to the business associations, we had access to the firms and our response rate was of 167, reflecting a very high representative sample according to previous respondent patters of other studies focused in the same sector (Alegre and Chiva 2008). Our final sample was composed by 105 final producers, 26 frits and glazes firms and 36 manufacturers of equipment.

2. Measures

2.1. Product innovation performance

For the understanding of product innovation performance we followed the well-known definition of the Oslo Manual (OCDE/Eurostat 2005). Following this conceptualization, studies have approached it through different measures. In this study we have operationalized product innovation as the share of innovative products in turnover introduced into the market during the last three years[12], differentiating between innovations that are new to the firm that is to say, imitative innovations, and those that are new to the market (Leiponen & Helfat 2010). Respondents could grade the perceived value into six categories, where the first category indicated that no product innovation accounted for the firm's sales figures and the last category indicated that more than 50% of the sales were due to firm's product innovations. However, in our final analysis we grouped together the three last categories because they had

[11] We estimated the population by considering the firms' belonging to the business associations of the sector: ASCER that comprises 132 firms, ANFECC (National Spanish Association of Ceramic Frits, Glazes and Ceramic Pigments) counts with 26 firms and ASEBEC (Spanish Association of Manufacturers of Machinery and goods of equipment for the ceramic industry) with 71 firms. These firms represent nearly the whole population.

12 The share of innovative products in turnover includes i) technologically new products introduced to the market within the last three years and, ii) technologically improved products introduced to the market within the last three years. In this study, a technological new product is one whose technological characteristics or intended uses differ significantly from those of previously produced products, whereas a technologically improved product refers to an existing product whose performance has been significantly enhanced or upgraded (OCDE/Eurostat 2005).

less than five cases in each one. Thus, the final dependent variable resulted in four final categories ranging from 1 to 4, where the last category indicated that more than 10% of the sales had been generated through the pursue of product innovations.

We believe that the share of innovative products in turnover is a correct choice because it captures the successful introduction of new products in the market, which is important because it requires efficient interactions between R&D and other functions, such as production and marketing (Miotti & Sachwald 2003). Moreover, distinguishing product innovation by their degree of novelty allows us to understand how partnering with different agents leads to different types of innovation.

2.2. Partnering

For the conceptualization of firm's external knowledge sources we considered the most relevant actors within the district: suppliers, universities and research institutes. In relation to these agents respondents were asked three separate questions concerning partnering during the last three years. In this sense, respondents answered 1 if the firm had established a relationship with each agent and 0 otherwise.

In figuring out the divergent sourcing patterns, literature has, among other classifications, differentiated between scientific and industrial sources. For empirical validation purposes we performed an exploratory factor analysis (see the Appendix) and eventually a two-factor solution was obtained where partnering with suppliers strongly loaded on the first factor while partnering with universities and research institutes strongly loaded on the second factor. These results confirm that partnering with suppliers differs substantially from partnering with scientific-based institutions. According to these results we created a construct integrating the questions related to the partnering of universities and research institutes, which takes value 1 if the firm had partnered with a university or a research institute and 0 otherwise. The Cronbach's alpha (α) of the scale was 0.71.

2.3. Knowledge sharing mechanisms

To measure the extent of knowledge sharing in the firm we used a construct composed of two questions. The first question asked for the availability of an intranet at the firm and the second, asked about the existence of a system of information management. In reference to the latter we concretely asked for the existence of the Enterprise Resource Planning System (ERP), which integrates the firm's practices associated with operational or productive activities assuring that all information is available for everybody at all time. The resulting variable was calculated as an arithmetic mean and takes values ranging from 1 to 4 depending on the availability of the firm of these mechanisms (α=0.79).

2.4. Formalization based mechanisms

Respondents were asked to grade the degree of formalized procedures for the development of managerial activities and/or production existent in the firm. The responses were classified from "totally in disagreement" to "totally in agreement", taking values from 1 to 4.

2.5. Knowledge incentives

Respondents were asked to answer to the following statements: The firm provides incentives so employees contribute with new ideas and the firm provides incentives oriented towards the upgrade or improvement of employees knowledge and skills. The resulting variable was

calculated as a mean of the answers given to these two questions and take values 1-4, ranging from "totally in disagreement" to "totally in agreement"(α=0.88).

2.6. Control variables

Besides the explanatory variables discussed above we summon to the analysis controls for scientific and technological capabilities. Even though the focus of our analysis is the role of managerial practices in the exploitation of external knowledge, controlling for internal technological capabilities of the firm becomes necessary in order to provide coherence to our results. For its approximation we asked the following questions. One, if during the last three years the firm incorporated employees with experience in the public system of R&D and two, if during the last three years the firm incorporated employees with business experience in R&D. No differences were find between these two responses (t-test) so the resulting variable was calculated as one, whether the firm incorporated employees in the public or private system of R&D and 0 otherwise (α= 0.66). Besides controlling for technological capabilities we also controlled for the type of activity realized in the district (frits and glazes, final producers or manufacturers of equipment), the collaboration within the same group of enterprises (limited cases) and the size of the firm. A resume of these variables can be found in **Table 1.**

ANALYSIS AND RESULTS

Table 2 presents the descriptive statistics and the bivariate correlations between the variables used in the regression models. From the table, it can be observed that 62% of the firms in the sample had partnered with scientific agents and 81% had partnered with suppliers during the last three years. These results confirm that the number of external collaborations is higher than the average probably due to industrial district effects. According to the variables related with managerial practices, knowledge sharing and formalization-based mechanisms are on average quite high, meanwhile knowledge incentives are used to a lower extend. Besides, the correlations between the independent variables of the study aren't correlated in more than p=0.38. Furthermore, we calculated variance inflation factors (VIFs) and the maximum value reported was of 1.92, which is below the rule-of-thumb of 10 (Neter et al. 1996). These indicators indicate that there are no problems associated with multicollinearity.

Table 3 and Table 4 present the results of the regressions on imitative and new-to-the market innovations respectively. Our hypotheses were tested using the ordinal logistic regression technique[13] and by means of eight econometric models. The first four models study imitative innovations by considering the direct and moderator effects of all of our explanatory variables. Models from 4 to 8 are also concerned with the direct and interaction effects but focusing on new-to-the-market innovations.

Our models present significant Chi-squared statistics suggesting that the complete model gives a significant improvement over the baseline intercept-only model. Moreover, the values of the Cox and Snell R^2 for the direct effects models are of 0.35 for imitative product innovations and

[13] The dependent variable is a discrete and inherently ordered multinomial-choice variable, which takes the value 1 to 4. The reference category for the analysis is the one that takes value 4, that is to say, the one in which the share of turnover due to product innovations was superior to 10%. Moreover, ordinal regressions assume that the relationships between the explanatory variables and the logits are the same for all the logits. This assumption is checked by the test of parallel lines for all of our models.

0.38 for new-to-the-market innovations. These values always increase when intercepts are considered, thus indicating that more variance is explained when incorporating the moderator effects.

The results related with main effects, that is model 1 and model 5, reveal the strong effect suppliers exert on both types of innovation. This result is expected due to the idiosyncrasy of the sector under study. Suppliers mainly drive innovations in the ceramic tile industry, so it is not surprising that partnering with this particular agent appears as a fundamental factor in achieving product innovations. Moreover, when the novelty of innovation is considered partnering with suppliers tends to be more important for imitative innovations as theorized in hypothesis 2. In the case of scientific agents the direct relationship is not supported, thus we reject hypothesis 1. Internal technological capabilities also appear as a relevant factor in the accomplishment of innovations, underscoring the necessity of internal research and development when planning to innovate, especially when innovation is more novel in nature. Moreover, although the focus of the paper is on the moderating effect of managerial practices it is worth outlining that knowledge incentives exert a strong direct effect in both types of innovations, while knowledge sharing mechanisms also appear important when the innovation is new to the market.

The previous results revealed a strong effect of suppliers on innovation in detriment of scientific agents. We further analyze the moderating effects in order to understand how introduction of managerial practices modify the direct relationships. On the first place, we find that scientific agents are relevant in the achievement of imitative innovations when knowledge-sharing mechanisms are considered. To this respect Hypothesis 3 is partially accepted. Second, we find that the moderating effect of knowledge-sharing mechanisms between suppliers and innovation is not significant. This result is consistent with our hypothesis 4.

In relation to formalization based mechanisms our results are in line with the stream of the literature, which posits a possible negative effect on the exploitation of external knowledge because of creation of rigidities within the organization. In particular, the results present a negative moderating relationship between the partnering with scientific agents and innovation, especially when the innovation is new-to-the market. Thus, hypothesis 5b findings are confirmed by our data. In the case of industrial agents no significant results are found, hence we reject hypothesis 6.

Lastly, regarding knowledge incentives our results surprisingly present a significant negative interaction effect between suppliers and innovation results and no significant effects in relation to scientific agents. A possible explanation for these results could be that incentives are not creating new knowledge nor promoting knowledge share between the employees, thus the implementation of this human resources policy result just in an additional cost for the firm. An alternative explanation could be that due to the strong direct positive effect of incentives on innovation, employees are searching knowledge within the firm and not focusing on integrating the knowledge coming from outside for innovation purposes.

Table 1

Description of variables

Variable	Description	Scale of measurement
Imitative product innovations	Share of 2011 turnover due to product innovations introduced during 2009-2011, which were new to the firm.	1: 0 % 2: 0-5 % 3: 5-10 % 4: more than 10%
New-to-the-market product innovations	Share of 2011 turnover due to product innovations introduced during 2009-2011, which were new to the market.	1: 0 % 2: 0-5 % 3: 5-10 % 4: more than 10%
Scientific partners	The firm has partnered with scientific agents in the period 2009-2011.	0: No 1: Yes
Suppliers	The firm has partnered with suppliers in the period 2009-2011.	0: No 1: Yes
KSM	Knowledge sharing mechanisms: Intranet and ERP.	1: Not available in the firm 2: Their development is not foreseen 3: In development 4: Available in the firm
FBM	Formalization based mechanisms: Procedures for the development of managerial activities and/or production are formalized.	1: Totally in disagreement 2: In disagreement 3: In agreement 4: Totally in agreement

Table 1 (continued)

Description of variables

Variable	Description	Scale of measurement
KI	Knowledge incentives: Existence for employees to contribute with new ideas and existence of incentives for employees to update or improve their knowledge and/or skills.	1: Totally in disagreement 2: In disagreement 3: In agreement 4: Totally in agreement
S&T capabilities	Scientific and technological capabilities: The firm incorporated employees in the public/private system of R&D	0: No 1: Yes
Activity	Activity in which the firm is specialized.	1: Final producers 2: Frits and glazes firms 3: Manufacturers of equipment
Size	Ln of total number of employees.	Continuos values
Group	The firm has related with other firms of the same group.	0: No 1:Yes

Table 2
Descriptive statistics

	Mean	Median	S.D.	Minimum	Maximum	1	2	3	4	5	6	7	8
1. S&T capabilities	0,16	0	0,37	0	1	1							
2. Scientific partners	0,62	1	0,49	0	1	0,14	1						
3. Suppliers	0,81	1	0,39	0	1	0,08	0,23**	1					
4. Knowledge sharing mechanisms	3,2	3,5	0,9	1	4	0,20**	0,29**	0,16*	1				
5. Formalization based mechanisms	3,21	3	0,65	1	4	0,19*	0,22**	0,14	0,23**	1			
6. Knowledge incentives	1,95	2	0,97	1	4	0,2*	0,08	0,16*	0,19*	0,20**	1		
7. Activity	1,53	1	0,75	1	3	0,13	0,23**	0,04	0,24**	0,07	0,26**	1	
8. Size	4,02	3,97	1,08	0,69	6,77	0,19*	0,31**	0,28**	0,38**	0,25**	0,16*	(0,27)**	1
9. Group	0,4	0	0,49	0	1	0,30**	0,28**	-0,02	0,32**	0,15	0,16*	0,19*	0,23**

* $p < 0,05$

** $p < 0,01$

Table 3

Ordered logit regression results: Explanatory variables of imitative product innovations

Variable	Model 1		Model 2		Model 3		Model 4	
	Estimate	t-value	Estimate	t-value	Estimate	t-value	Estimate	t-value
S&T capabilities	0,95	2,90*	0,96	2,98*	0,85	2,25	0,67	1,49
Scientific partners	-0,16	0,17	-3,75	4,28**	3,71	3,42*	-1,14	1,64
Suppliers	2,29	18,8***	4,03	4,79**	2,97	0,75	6,95	16,96***
Knowledge sharing mechanisms (KSM)	0,36	2,16	0,57	1,17	0,36	2,09	0,29	1,34
Formalization based mechanisms (FBM)	0,44	2,08	0,42	1,86	1,27	1,41	0,48	2,25
Knowledge incentives (KI)	0,49	6,04***	0,53	6,97***	0,45	5,07**	2,81	12,27***
Activity	-0,34	0,79	-0,54	1,88	-0,34	0,81	-0,35	0,76
Size	-0,06	0,09	-0,19	0,71	-0,01	0	0,12	0,3
Group	-0,35	0,82	-0,513	1,66	-0,33	0,73	-0,38	0,9
Scientific partners*ISM			1,12	4,31**				
Suppliers*ISM			-0,58	1,07				
Scientific partners*FBM					-1,22	3,88**		
Suppliers*FBM					-0,23	0,04		
Scientific partners*KI							0,36	0,81
Suppliers*KI							-2,72	11,30***
Number of observations		131		131		131		131
Log likelihood test		52,50		57,77		56,76		65,82
Pseudo R^2 (Nagelkerke)		0,35		0,38		0,38		0,43

*p < 0,10

**p < 0,05

***p < 0,01

Table 4

Ordered logit regression results: Explanatory variables of new-to-the-market product innovations

Variable	Model 5		Model 6		Model 7		Model 8	
	Estimate	t-value	Estimate	t-value	Estimate	t-value	Estimate	t-value
S&T capabilities	1,75	9,31***	1,72	9,01***	1,74	8,98***	1,51	6,97***
Scientific partners	0,56	1,98	-1,54	0,77	5,73	7,91***	1,15	1,63
Suppliers	1,98	13,82**	3,61	3,96**	5,18	1,71	5,66	12,29***
Knowledge sharing mechanisms (KSM)	0,44	3,18*	0,7	1,78	0,41	2,69	0,3	1,35
Formalization based mechanisms (FBM)	-0,17	0,31	-0,19	0,39	1,62	1,67	-0,26	0,64
Knowledge incentives (KI)	0,73	12,36***	0,75	13,01***	0,71	11,64***	3,01	14,22***
Activity	-0,17	0,2	-0,31	0,6	-0,15	0,15	-0,16	0,15
Size	-0,21	0,97	-0,27	1,55	-0,12	0,29	-0,02	0,01
Group	0,74	3,48*	-0,82	4,04**	0,75	3,44	-0,81	3,87**
Scientific partners*ISM			0,66	1,57				
Suppliers*ISM			-0,54	0,94				
Scientific partners*FBM					-1,63	6,88***		
Suppliers*FBM					-1,04	0,69		
Scientific partners*KI							-0,39	0,92
Suppliers*KI							-2,21	8,10***
Number of observations		131		131		131		131
Log likelihood test		56,50		58,79		65,21		65,95
Pseudo R^2 (Nagelkerke)		0,38		0,39		0,43		0,43

*p < 0,10

**p < 0,05

***p < 0,01

DISCUSSION AND CONCLUSION

This study has analyzed the role of managerial practices as important determinants in the process involving the transformation and utilization of external knowledge. Following the framework provided by absorptive capacity and organizational learning literatures this study deepens further in this under researched field by discriminating between firm's external knowledge sources and analyzing how certain managerial practices condition the ultimate exploitation of the absorbed knowledge. In particular, we studied firm's partnering with suppliers, universities and research institutes and, managerial practices oriented to the coordination of knowledge (knowledge sharing and formalization based mechanisms) and the search for new knowledge in the context of the Spanish Ceramic Tile industry.

Our findings reveal that in the case of this sector the principal driver of innovation are suppliers. These results confirm that for supplier-dominated firms partnering with these agents is crucial in the development of new or improved products. Moreover, when taking into consideration the novelty of the innovation, firms partnering with suppliers attain both types of innovation, although imitative innovations seem to be of major importance. In contrast to this source of innovation, universities and research institutes do not exert a direct impact on innovation. However, when considering the moderating effects of managerial practices scientific partners gain significance.

To this respect, when external knowledge is acquired through scientific partners mechanisms involved with knowledge sharing build positively on the firm's capability of exploiting external knowledge. Formalization based mechanisms also present significant moderating effects between the firm's partnering with scientific agents and its effect on innovation, however, this time effects are negative. In this sense, we can argue that only practices related directly with knowledge sharing have coordination properties and this is the reason of positive significant effects on the exploitation of external scientific knowledge. Practices that enhance formalized procedures do not favor the flow of information within the organization and thus, exert a detrimental effect on the exploitation of external scientific knowledge.

Incentives oriented towards the creation and search for new knowledge have been quite forgotten within this literature, though the scant literature posits a positive effect of these mechanisms on the exploitation of external knowledge. Surprisingly, our results convey that knowledge incentives do not moderate the relationship between partnering with scientific agents and product innovation. Even, this relationship turns negative and significant in the case of suppliers. A possible explanation to this result is that knowledge incentives could be motivating the search inside the organizational boundaries in detriment of ideas coming from the exterior. An alternative explanation could be a deficient implementation of this policy and the corresponding additional costs incurred by the organization.

Previous attempts to explain firm's success in exploiting external knowledge have centered their attention on technological capabilities. However our results show that not only R&D activities and other related activities are important, but that certain organizational characteristics should also be also taken into consideration. Moreover, these results show that the influence of managerial practices on the exploitation of external knowledge can be positive or negative depending on the nature of such practice. Also, our results demonstrate that the moderating effect of managerial practices between external knowledge sourcing and innovation is contingent on the type of partner involved in the sourcing process and the degree of novelty found in innovation results.

Besides theoretical and empirical contributions, this work has also practical implications for managers. In current complex environments the role of external knowledge and its influence on innovation has been an increasingly relevant issue. In this sense, for managers to understand the role of managerial practices in leveraging external knowledge to successful innovations becomes definitely crucial.

LIMITATIONS AND FURTHER RESEARCH

In the following lines we will acknowledge the most salient limitations of our study. This study used questionnaire research, thus, perceptual measures and single-sources responses present a shortcoming to our investigation. Moreover, we were unable to contrast the dependent variable with other objective measures, although we endeavor to collect this data on the future. Eventually, counting with a larger data set would be beneficial mainly because some of the non-significant relationships could become significant. Moreover, a multi-sector analysis will allow us to generalize results.

Even though most of the hypothesis were in line with theorized it is true that some cases were more surprising and more difficult to understand. For instance, incentives were thought to exert a positive effect on the exploitation of external knowledge and contrarily, the effect was non significant in the case of scientific agents and negative in the case of industrial agents. Even though we advanced some possible explanations it would be of interest to pursue additional interviews in the future in order to analyze the rare cases and the results that are not clear.

This study is only a first step in exploring the importance of managerial practices in the exploitation of external knowledge. Further research could extend our study by focusing on additional dimensions of external knowledge sourcing, such as the mechanisms involved (licensing, collaborating…) or the nature of the search (i.e. exploitative/explorative; breath/depth). Moreover, future studies could deepen into the recent discussion involving new organizational forms and consequently add richness into the present research.

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Annexes: Exploratory factor analysis

Factor loadings from principal component analysis (Varimax rotation, n=131)

	Factor 1	Factor 2
Suppliers	0,162	**0,986**
Universities	**0,881**	0,108
Technological centers	**0,858**	0,182

* Kaiser-Meyer-Olkin measure of sampling adequacy: 0,60

Bartlett's test of sphericity: approx. chi-square: 78.09; p=0,000.