VNIVERSITAT DE VALÈNCIA Facultat d'Economia

Departament de Direcció d'Empreses "Juan José Renau Piqueras"

DETERMINANTS AND EFFECTS OF EXTERNAL KNOWLEDGE SEARCH: FOCUSING ON ORGANIZATIONAL FORMAL STRUCTURE

TESIS DOCTORAL

PRESENTADA POR:

Ana García Granero

DIRIGIDA POR:

Dr. Jaider Manuel Vega Jurado

Dr. Joaquín Alegre Vidal

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INGENIO(CSIC-UPV)
Universitat Politècnica de València;

Escuela de Negocios
Universidad del Norte

Dr. Joaquín Alegre Vidal

Departamento de Dirección de Empresas 'Juan José Renau Piqueras'
Universitat de València

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A Nacho

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ABSTRACT

Studies in the economic approach to innovation have highlighted the relevance of external knowledge for the development of firm's innovation processes. In the same line, it has been acknowledged that the exploitation of external knowledge sources is mostly depedent on firm's internal capacities or commonly known as the firm's absorptive capacity. Absorptive capacity has been basically associated to the firm's internal knowledge base, as a result of R&D activities. This is the reason for the development of several studies on the development of internal technological capacities and the exploitation of external knowledge. These studies show contradictory results that state the necessity of broadening the spectrum of factors influencing the configuration of search and exploitation processes of external knowledge.

Management literature provides interesting insights in this last point. This literature highlights the role of firm's organizational structure, understood in terms of decentralization of decision-making and formalization of organizational processes, in enabling learning and innovation. In general this literature pays special attention to knowledge processes within firm's boundaries. Thus, in this thesis we build on this literature and extent it to the particular case of external knowledge sourcing processes.

Specifically, we examine the effect of organizational structure in 1) the configuration of external search strategy and 2) the exploitation of external knowledge in innovation results.

The thesis is structured in two main blocs. In the first part, we pursue a critical review of the literature. On the one hand, we review the approaches to external knowledge search and innovation. On the other hand, we look at studies examining organizational formal structure, and on basis to the lessons learned we develop the hypotheses in relation to both research questions. In the second part we define the empirical model.

The analyses are performed on basis to a survey administered to ceramic manufacturers.

Main conclusions are as follows: Regarding the first research question, results show that a decentralized structure plays a role in shaping the firm's external search strategy. In particular, a decentralized structure encourages the use of an exploratory search strategy to the detriment of exploitative search. On the other hand, results related with the second research question, show that formalization tends to have a detrimental effect in the transformation of external knowledge into innovation outputs, especially in the case of exploratory innovations. Other conclusions involving the role of technological resources and environmental context in external knowledge processes are also derived.

Moreover, these results have relevant managerial and policy implications. The results inform managers by showing that organizational structure is determinant in the search strategy pursued. Also, it demonstrates that structure has an effect on the exploitation of external knowledge, particularly, in different types of innovation. Policy-makers, on their side, are adviced to consider firm's characteristics in the frame of policies oriented towards partnerships among external agents and firms.

RESUMEN

Muchos enfoques económicos sobre innovación han destacado la importancia del conocimiento externo para el desarrollo de procesos de innovación. En esta misma línea, también se ha reconocido que la explotación de las fuentes externas de conocimiento depende en gran medida de las capacidades internas de la empresa o lo que se conoce por capacidad de absorción empresarial. Dicha capacidad ha sido fundamentalmente asociada a la base de conocimiento interno de la empresa, derivada del desarrollo de actividades de I+D. Es así como se han llevado a cabo diversos estudios acerca de la relación existente entre el desarrollo interno de competencias tecnológicas y la explotación de conocimiento externo. Sin embargo, estos estudios han arrojado resultados contradictorios, que ponen de manifiesto la necesidad de ampliar el espectro de los factores que influyen en la configuración de los procesos de búsqueda y explotación de conocimiento externo.

La literatura de gestión de empresas aporta una perspectiva interesante a este último punto. Esta literatura destaca el papel de la estructura organizativa, entendida en términos de formalización de los procesos y descentralización en la toma de decisiones, en la activación de procesos de aprendizaje e innovación. En general, se pone especial atención en los procesos de adquisición de conocimiento que tienen lugar en el interior de la empresa. Por tanto, esta tesis bebe de esta literatura y la aplica al caso particular de los procesos de adquisición de conocimiento externo.

Específicamente, examinamos el efecto de la estructura organizativa en 1) la configuración de la estrategia asociada a la búsqueda de conocimiento externo y 2) la explotación de conocimiento externo en términos de resultados de innovación.

La tesis se estructura en dos grandes bloques. En una primera parte, se realiza una revisión crítica de la literatura. Por una parte, se revisan los

enfoques sobre búsqueda de conocimiento externo e innovación. Por otro lado, se examinan los estudios sobre estructura organizativa, y en base a las lecciones extraídas de dicha revisión, se desarrollan las hipótesis referentes a las dos preguntas de investigación formuladas. En la segunda parte, se define el modelo empírico. Los análisis se desarrollan en base a una encuesta dirigida a las empresas manufactureras pertenecientes al sector cerámico.

En general, las principales conclusiones de la tesis son las siguientes: En relación a la primera pregunta de investigación, los resultados demuestran que las estructuras descentralizadas juegan un rol relevante en la configuración de estrategias asociadas a la búsqueda externa de conocimiento. En particular, este tipo de estructuras estimula el uso de una búsqueda de tipo explorativa. Por otro lado, los resultados relacionados con la segunda pregunta de investigación, muestran que la formalización ejerce un efecto negativo en la transformación del conocimiento externo en términos de resultados innovadores, especialmente en el caso de innovaciones de tipo explorativo. Otras conclusiones en relación a los recursos tecnológicos y al entorno también se derivan de este estudio.

Además, los resultados tienen importantes implicaciones prácticas. Por un lado, los resultados son de utilidad para la dirección ya que sugieren que la estructura organizativa es determinante en la estrategia de búsqueda formulada y en el efecto de la estructura sobre la explotación de conocimiento externo. Por otro lado, las conclusiones informan a los responsables políticos de que es relevante considerar las características empresariales en la elaboración de políticas públicas orientadas al fomento de la interacción entre empresas y agentes del entorno.

RESUM

Molts enfocaments econòmics sobre innovació han destacat la importància del coneixement extern per al desenvolupament de processos d'innovació. En aquesta mateixa línia també s'ha reconegut que l'explotació de les fonts externes de coneixement depèn en gran mesura de les capacitats internes de l'empresa o el que es coneix per capacitat d'absorció empresarial. Aquesta capacitat ha estat fonamentalment associada a la base de coneixement intern de l'empresa, derivada del desenvolupament d'activitats de R + D. És així com s'han dut a terme diversos estudis sobre la relació existent entre el desenvolupament intern de competències tecnològiques i l'explotació de coneixement extern. No obstant això, aquests estudis han donat resultats contradictoris, que posen de manifest la necessitat d'ampliar l'espectre dels factors que influeixen en la configuració dels processos de recerca i explotació de coneixement extern.

La literatura de gestió d'empreses aporta una perspectiva interessant a aquest últim punt. Aquesta literatura destaca el paper de l'estructura organitzativa, entesa en termes de formalització dels processos i descentralització en la presa de decisions, en l'activació de processos d'aprenentatge i innovació. En general, es posa especial atenció en els processos d'adquisició de coneixement que tenen lloc a l'interior de l'empresa. Per tant, aquesta Tesi beu d'aquesta literatura i l'aplica al cas particular dels processos d'adquisició de coneixement extern.

Específicament, examinem l'efecte de l'estructura organitzativa en 1) la configuració de l'estratègia associada a la recerca de coneixement extern i 2) l'explotació de coneixement extern en termes de resultats d'innovació.

La Tesi s'estructura en dos grans blocs. En una primera part, es realitza una revisió crítica de la literatura. D'una banda, es revisen els enfocaments

sobre recerca de coneixement extern i innovació. D'altra banda, s'examinen els estudis sobre estructura organitzativa, i sobre la base de les lliçons extretes d'aquesta revisió, es desenvolupen les hipòtesis referents a les dues preguntes de recerca formulades. A la segona part, es defineix el model empíric. Els anàlisis es desenvolupen d'acord amb una enquesta dirigida a les empreses manufactureres pertanyents al sector ceràmic.

En general, les principals conclusions de la tesi són les següents: En relació a la primera pregunta d´investigació, els resultats demostren que les estructures descentralitzades juguen un rol rellevant en la configuració d'estratègies associades a la recerca externa de coneixement. En particular, aquest tipus d'estructures estimula l'ús d'una recerca de tipus explorativa. D'altra banda, els resultats relacionats amb la segona pregunta d´investigació, mostren que la formalització exerceix un efecte negatiu en la transformació del coneixement extern en termes de resultats innovadors, especialment en el cas d'innovacions de tipus exploratiu. Altres conclusions en relació als recursos tecnològics i a l'entorn també es deriven d'aquest estudi.

A més a més, els resultats tenen importants implicacions pràctiques. D'una banda, els resultats són d'utilitat per a la direcció ja que suggereixen que l'estructura organitzativa és determinant en l'estratègia de recerca formulada i en l'efecte de la estructura en relació a l'explotació del coneixement extern. D'altra banda, les conclusions informen als responsables polítics que és rellevant considerar les característiques empresarials en l'elaboració de polítiques públiques orientades a fomentar la interacció entre empreses i agents de l'entorn.

Chapter 1:

General Introduction

Innovation is central in establishing and sustaining competitive advantage of firms (Nelson, 1991; Teece, Pisano and Shuen, 1997). The evolution of an increasingly complex environment has placed innovation as an indispensable option when planning to increase firms' performance and assure its growth and ultimate survival (Damanpour, 1991; Daellenbach, McCarthy and Schoenecker, 1999).

Innovation can be defined as the successful implementation of new ideas (Myers and Marquis, 1969; Amabile et al., 1996). This interpretation of innovation includes novelty and use as two conditions that must be fulfilled. In this sense, innovation not only requires of new ways of solving problems but also involves use or achievement of commercial success. In this sense, innovation has resulted to be a very complex process presenting high failure rates (Stevens and Burley, 1997; Wu et al., 2005). However, despite the difficulty in attaining innovation, its relevance has driven the flourishing of numerous studies, which inquire into the determinants that lie behind the explanation of innovation (Vega-Jurado et al., 2008b; Tsai, 2009).

External knowledge is gaining importance as a central determinant of innovation performance. Firm's boundaries are becoming blurred and some authors have even referred to organizations as boundary less and highly open to their external environment (Child and McGrath, 2001). Empirical evidence exemplifies clearly the increasing importance of firms' external knowledge sourcing in the process leading to innovative results. For instance, the external expenditure in research and development (R&D) for Spanish manufacturing industries augmented from 7.02% to 16.17% during the period 1996-2007 (INE, 2010). Also, the database MERIT-CATI, which offers information on the formal agreements on technological cooperation, shows that during the last 40 years collaboration agreements rose from an average of 10 agreements to more than 600 agreements per year (Hagedoorn, 2002).

Also, current economic theories on innovation have underlined the increasing relevance of external knowledge coming from other firms or institutions for the development of new product and processes (Von Hippel, 1988; Cassiman and Veugelers, 2006). Moreover, studies in this tradition have investigated the potential factors influencing the effect of external knowledge on innovation. Borrowing insights from the absorptive capacity theory, these studies have considered internal generation of knowledge, mainly through technological resources, as one of the main contingencies (Cohen and Levinthal, 1989/1990).

However, studies in this tradition, that is, analyzing the links between external knowledge sourcing and internal knowledge generation, show controversial results (Cassiman and Veugelers, 2006; Tsai and Wang, 2009; Vega-Jurado et al., 2009). This calls for a need for further theoretical and empirical research on the factors influencing the firm's ability to acquire and exploit external knowledge for innovating.

Thus, we argue that studies in economic tradition have focused to a large extend on firms internal technological resources and that scant attention

has been paid to the firm's organizational dimension in the acquisition and exploitation of external knowledge. Even though scholars have recognized the importance of organizational factors in external knowledge sourcing processes (Cohen and Levinthal, 1990; Zahra and George, 2002), many empirical studies allow little room for the analysis of how this external knowledge is transformed and used within the organization itself. Faems et al. (2005), for instance, explicitly mentions that the amount of unexplained variance in their model could be related to the absence of organizational factors that substantially influence how and to what extent organizations innovate. Thus, by focusing exclusively on the technological content of knowledge, these studies have neglected that the introduction of the firm's organizational dimension can help explain the controversial results.

Recently, and through the framework of absorptive capacity, the studies of Van den Bosch et al. (1999), Jansen et al. (2005), Vega-Jurado et al. (2008a), Foss et al. (2010) and Gebauer et al. (2012) have analyzed the role of organizational factors in external knowledge sourcing processes. However, these studies are scarce and different in terms of, theoretical constructs, methodologies, unit of analysis etc. In this sense, the comparability of studies becomes highly complicated. Thus, more research is necessary in this direction. This thesis focuses on the firm's organizational formal structure, understood as decentralization of decision-making and formalization of organizational processes, and develops theoretically and empirically its influence on the acquisition and exploitation of external knowledge. In the theoretical development we will build on management literature which offers very interesting insights into this last point.

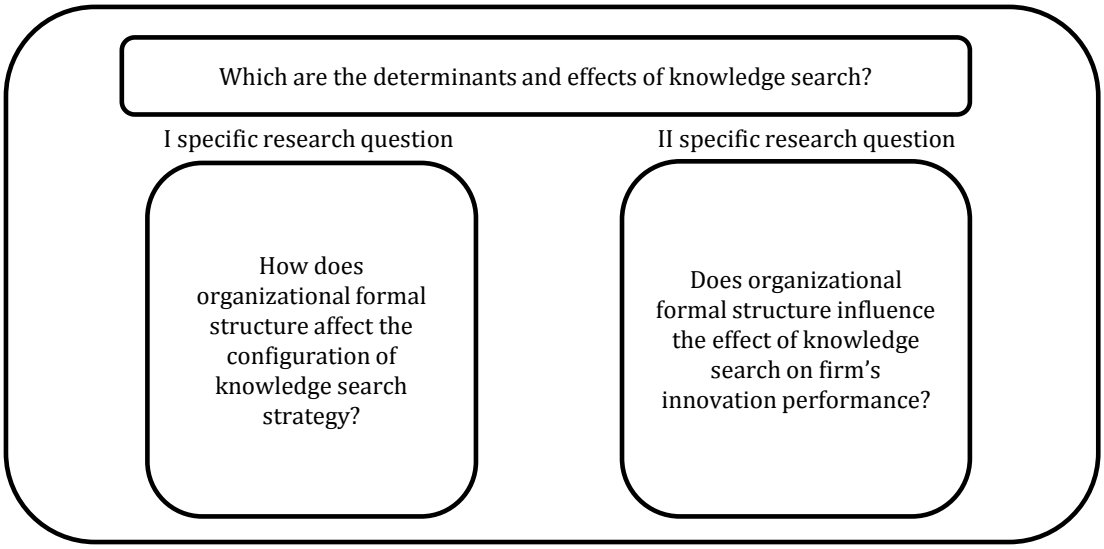
Management literature has traditionally focused on the internal dimension of the firm, deepening on the organizational structures enabling learning and the leverage of knowledge for innovation (Damanpour, 1991; Jansen

et al., 2006). It is true that some recent literature in this tradition has recognized that many essential resources and capabilities lie outside the boundaries of the firm (Song et al., 2005). According to the organizational learning literature, for instance, the search for new ideas has gone beyond the firm boundaries because of the necessity of exploring new capacities lying in other firms or organizations (March, 1991). However, overall, this literature has focused on how firms should be configured to manage and direct knowledge that is confined within the organization's boundaries.

Specifically, organizational learning scholars have introduced exploration and exploitation as two concepts that help to describe the intentionality and strategy pursued by firms and different types of innovation. In this sense, analyzing exploration and exploitation in both, process and outcome, helps us to understand the extent to which organizations expect to search for related or/and unrelated knowledge to that of their knowledge base, and the extent to which firms innovations are based on related or/and distant knowledge areas.

This literature will enrich our investigation, which addresses generally the question regarding the determinants and effects of knowledge search. In this sense, the thesis will answer two specific research questions: (i) How does organizational formal structure influence the configuration of knowledge search strategy? (ii) Does organizational formal structure influence the effect of external search strategy on firm's innovation performance? Figure 1.1 summarizes the general and specific research questions of the thesis.

Figure 1.1 General and specific research questions



Source: Authors' elaboration

The empirical research will be developed in the context of Spanish ceramic tile industry. Spanish ceramic tile firms play a relevant role in the international ceramic industry and present high innovative rates (Alegre and Chiva, 2008). A relevant characteristic of this sector is its organization around an industrial district. In districts, firm's reliance on external knowledge is generally high thus making this sector a suitable case for analysis. In other words, studying this sector will proportionate interesting insights into the the determinants and effects of knowledge search.

To conclude, the overall premise of this thesis is that there is need for more research to link external knowledge sourcing processes with the organizational dimension of the firm and to understand the role of strategy in this relationship. In this sense, we argue that distinct fields of innovation should interact more often in order to understand the role of organizational structure in knowledge sourcing processes firms are confronted with. In words of Shafique (2012) "fields of innovation are becoming compartmentalized" and "this tendency of self-containment is disconcerting because it may hinder tapping the full potential of research in this innately multidisciplinary".

In general terms, the thesis is structured in two main areas, that is, the first (chapter 2 and 3) area constitutes the theoretical part of the thesis. In these chapters we review the literature from both an economic and management approach. The second main area (chapter 4 and chapter 5) corresponds to the empirical investigation. In these chapters we will analyze the determinants and effects of knowledge search in the ceramic tile industry.

Chapter 2 introduces the general thoughts provided by economic approaches to innovation. Specifically, we highlight the trend towards external sources of knowledge as a major determinant of innovation. In this revision we point out the strengths and weaknesses of the studies in this tradition, especially the absence of organizational factors in empirical studies. We propose studies in the management literature as a complementary framework to alleviate this weakness.

Chapter 3 reviews in depth management literature dealing with the sources of innovation, specifically the firm's formal structure. Moreover, this literature provides additional insights to the role of exploration and exploitation. Contributions in this area will guide the development of the hypotheses.

Chapter 4 presents the empirical setting of this investigation. In this chapter the sector will be characterized, specifically, in terms of firm's innovative behavior and degree of openness to the environment. Also, we will present the strategy pursued to collect the data. This will include the description of the questionnaire and of the characteristics of the sample. We will also describe the measurements approximating the central theoretical constructs to this thesis. Moreover, the descriptive statistics of these measurements will be calculated in order to get a general idea of the distribution of these variables. Specifically, we will deepen into the behavior of variables such as the breath and nature of firm's external knowledge sources and the types of innovation.

Chapter 5 analyzes the determinants and effects of knowledge search through the estimation of several econometric models. The results in this chapter will be analyzed and specific conclusions for each research question will be presented.

In addition to the partial conclusions offered in each chapter, the thesis will end up by offering a general conclusion which summarizes the findings. In this last part, an effort to integrate the partial findings and a general reflection on the effect of these results on the broad research field of innovation will be attempted. Practical and political implications will be discussed. Also, further lines of research will be pointed out.

Chapter 2:

Approaches to external knowledge search and innovation

2.1 INTRODUCTION

The purpose of this chapter is multiple. First, we will review the most relevant theoretical streams in economic tradition dealing with external knowledge sourcing and innovation. This literature acknowledges that knowledge is a broad concept and that it can be categorized into distinct types. Also, studies in this approach consider that external knowledge sourcing is dependent on two main factors, that is, the agents and mechanisms employed in the transfer of knowledge. In this line of thought, several authors have conceptualized strategies firms undertake in order to absorb distinct types of knowledge, which impact types of innovation. This chapter also summarizes the main views towards internal knowledge generation and external knowledge sourcing. Furthermore, we review the few studies integrating the firm's organizational dimension into external knowledge sourcing processes.

The organization of this chapter is as follows. In Section 2.2 we will describe distinct types of knowledge involved in external knowledge acquisition, frequent used analytical tools, conceptualizations towards search strategies, and the evolution in the approach of external knowledge sourcing studies. In section 2.3 we will highlight the key few studies that introduce the role of organizational dimension in the external knowledge sourcing processes. Section 2.4 concludes.

2.2 ECONOMIC APPROACHES TO EXTERNAL KNOWLEDGE SEARCH AND INNOVATION

2.2.1 The relevance of external knowledge

Recent trends reflect the exposure of firms to their environment, and the progressive opening of traditionally hermetic organizational boundaries. Several economic theories stress the role of external knowledge sources as a relevant determinant of innovation and they underline the importance of studying innovation as a phenomenon that goes beyond the boundaries of the firm.

Evolutionary theorists, for instance, understand innovation as the result of a process involving continuous learning between the firm and the multiple agents integrating the firm's environment (Lundvall, 1992; Breschi and Malerba, 1997). Also, innovation network theorists frequently study the success or failure of innovation processes by taking into account the characteristics and structure of the external agents surrounding the firm. For instance, they take into consideration aspects such as the diversity of external agents and the strength and weaknesses of the bonds between them. In short, they also argue that it is improbable for firms to

innovate by themselves; they should also leverage external knowledge to achieve superior results (Haakansson, 1987; Baptista and Swan, 1998).

More recently, the open innovation approach suggests that an important number of firms have shifted to an innovation model characterized by high levels of 'openness'. This model involves the contact with a wide range of external sources in order to leverage useful knowledge to provide a basis for the achievement of innovation results (Chesbrough, 2003; Chen et al., 2011).They even suggest that external knowledge has become more important than traditional knowledge produced through in-house R&D (Chesbrough, 2003; Laursen and Salter, 2006). Overall, accessing external knowledge is considered as a source of increasing innovation performance (Tsou, 2012).

2.2.2 Types of external knowledge

External knowledge is a broad concept. Knowledge can include expertise on marketing, management, and technology (Howells et al., 2003)[1]. Organizational learning and absorptive capacity based studies have underlined that the specific type of knowledge absorbed influences the ability of the firm to learn from its partner (Cohen and Levinthal, 1990; Lane and Lubatkin, 1998; Lavie and Rosenkopf, 2006; Knudsen, 2007). In words of Lane and Lubatkin (1998) "the ability of the student firm to learn from the teacher firm depends, among other things, on the specific type of new knowledge offered by the teacher" (p. 462)[2].

Cohen and Levinthal (1989/1990) pointed out that "although it is difficult to specify a priori all the relevant characteristics of knowledge 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 needs and concerns of the firm", that is, the degree of applicability of knowledge (p. 140). Following this idea, the authors associate basic research as an input of knowledge far from industrial

application and with added difficulties for its transfer to organizations; and applied research as more related to the knowledge base of the firm and easy to transfer to organizations.

Knowledge derived from basic research has been associated to scientific knowledge; and knowledge coming from applied research includes experimental development, design and prototype work (Howells et al., 2003). Scientific knowledge provides a deeper understanding of the searched area enhancing additional opportunities for extrapolation and learning. Moreover, researchers are able to form an expectation of the outcome without actually running the trial thus, focusing the research in the most likely areas of opportunity and eliminating the areas that would have proved fruitless (Fleming and Sorenson, 2004; Fabrizio, 2009). Scientific knowledge and knowledge developed through experimentation differ because the former provides an understanding of the underlying fundamental properties generating the observed outcome-knowledge of why, meanwhile the latter focuses on what happened (Jensen et al., 2007; Fabrizio, 2009). Moreover, other types of knowledge are also relevant for firms. For instance, firms look for new knowledge to commercialize products and services. This kind of knowledge includes marketing tools and other best practices (Li et al., 2008). In this sense, while technology knowledge is more associated to supply, market knowledge is highly related to demand (Sidhu et al., 2007).

These differences will have an effect on the type of learning needed to absorb the knowledge and its effects on innovation results. Thus, the nature of the knowledge absorbed has critical implications concerning knowledge management and its ultimate effect on the firm's innovation performance.

2.2.3 Agents and mechanisms involved in external knowledge sourcing

The type of knowledge accessed is highly bounded to the external agent accessed (suppliers, clients, universities, research institutes…) and the structure, also called mechanism and governance mode, in which the relationship builds (contracts R&D, collaborations…).

The works studying external knowledge sourcing thorough the lenses of structure have mainly discriminated between cooperating and buying external knowledge (Beneito, 2003; Vega-Jurado et al., 2009). On behalf of analytical purposes, literature has highlighted partnering (cooperating) and contracting as the two main modes of external knowledge governance, also known respectively as the 'cooperate' or 'buy' innovation (or technological) strategy. Distinct modes of governance have very different implications on the flow of knowledge into and out of the organization (Veugelers and Cassiman, 1999; Fey and Birkinshaw, 2005; Kask et al., 2012)[3].

R&D partnerships are based on interpersonal contact through formal or informal cooperative modes of R&D (Pisano and Teece, 1989; Howells et al., 2003). Thus, they imply the interaction of firms and specific external partners to undertake R&D projects. Partnerships can take multiple forms, such as partnering with universities and partnering with other firms in alliances including research consortia, joint ventures and strategic alliances (Fey and Birkinshaw, 2005). To this respect, in R&D partnering both parties interact and participate in the development of ideas in a process of mutual learning and adaptation resulting in the development of relatively context-specific and tacit knowledge (Hamel, 1991; Hagedoorn et al., 2000; Fey and Birkinshaw, 2005). However, eventually cooperation can consume more time for both of the parties; generate potential free-rider behaviors and possible conflict because of differences in the establishment of desired objectives and outcomes.

R&D contracting refers to the acquisition of knowledge in the market place (Fey and Birkinshaw, 2005). This includes primarily the outsourcing (contracting out) of particular R&D projects and the acquisition of technology licensed from second parties (Atuahene-Gima, 1992)4. The main difference with respect to R&D partnering is the limited opportunities left for learning for the contractee. While in partnering the primary objective is to jointly generate knowledge, in the case of contracting, the firm demands the contracting firm specific activities to be realized. Also, the firm can also be exposed to knowledge leakage from the firm because "firms usually allow the external provider to access their knowledge base in order to carry their work effectively" and contracting involves "less interaction, thus less opportunity for generating trust" (Fey and Birkinshaw, 2005). In this sense, leaving these activities in hands of other parties could also be risky in terms of weakening the firms technological competences (Coombs, 1996)[5]. However, despite these disadvantages contracting can also help the firm to "focus more on internal core capabilities, thereby facilitating faster product development (Tsai and Wang, 2009)." Moreover, additional benefits can be "managing capacity, speed, gaining access to new areas of knowledge, and sharing of costs" (Fey and Birkinshaw, 2005).

An additional stream of the literature has focused on analyzing the singularities of external sourcing according to the different agents involved in the process. These agents primarily include suppliers, customers, potential lead users, universities and research centers and even potential or existing industry competitors (Rosenkopf and Nerkar, 2001; Laursen and Salter, 2006). In general, these group of agents have been advanced as relevant for innovation (Miotti and Sachwald, 2003; Belderbos et al., 2004; Faems et al., 2005; Fey and Birkinshaw, 2005; Arranz and Fernández-de-Arroyabe, 2008; Tsai, 2009)[6]. In the following lines we will detail the characteristics of the main agents surrounding firms.

The importance of clients and users as sources of knowledge for innovation has been recognized since the decade of the 70s (Von Hippel, 1988). Working with customers not only provides benefits in identifying market opportunities for technology development, but also reduces the likelihood of poor design in the early stages of development (Tsai, 2009). In his seminal study Von Hippel (1988), goes even further, arguing that clients represent more than sources of knowledge. The development in certain fields of innovations by clients reflects that in some cases clients can become the origin of innovation.

Similarly suppliers have been underscored as being critical actors to a firms' innovation performance (Pavitt, 1984). Suppliers usually have greater expertise and more comprehensive knowledge regarding the parts and components of the firm's products. Thus, firms sharing knowledge with suppliers are more likely to recognize potential technical problems or new solutions to a firm's new product development efforts (Tsai, 2009). Moreover, this communication process enables a greater technological specialization and the reduction of the components costs significantly improving the operational efficiency of existing production processes (Vega-Jurado, 2008).

Both suppliers and clients form an integral part of the firms' value chain and thus differ in nature with competitors. Despite the advantages of collaborating with competitors, among others, sharing technological knowledge or reducing the time and risks of large projects, competitors are potentially dangerous because they sell on similar markets and may access the firm's own R&D resources (Tsai, 2009). This risk is understood by Veugelers and Cassiman (1999) as possible "involuntary outgoing spillovers" and it explains why accessing competitor's knowledge is the less frequent source. In this sense, Miotti and Sachwald (2003) have suggested that co-operation between competitors should be limited to two types of cases: First, when a particularly strong common interest has been

identified and, second, when the co-operation concerns far-from-market research leading to generic results.

To a certain extent the encouragement of public policies towards the collaboration of firms with universities and research institutions, has affected the increasing number of firms pursuing innovations by interacting with these agents. Moreover, several studies suggest that technological innovation relies heavily on knowledge from universities and research institutions (Bozeman, 2000). Universities have been frequently considered as an important source of scientific knowledge relevant for technological innovation, especially industries such as the biopharmaceutical and the pharmaceutical sectors, which are closely related to biology and chemistry departments at universities. Fabrizio (2009) studies this particular sector and concludes that firms enjoying enhanced access to university-generated scientific knowledge demonstrate superior search for new inventions in terms of greater speed.

In contrast to the use of industrial sources, that is, clients, suppliers and competitors; sources that depend on the public sector, entail less commercial risks as they do not follow as main objective the direct exploitation of knowledge. In this sense, co-operation with public institutions involves firms that draw heavily on close to science external R&D sources, increasing the firm's chance of introducing a technological breakthrough leading to a commercial product (Miotti and Sachwald, 2003; Spencer, 2003). In general terms, when firms search for universities or research centers they are looking for scientific knowledge, meanwhile when they source knowledge from suppliers or customers it is usually more applied in nature. Cohen and Levinthal (1990) distinguish between basic and applied research by providing different knowledge sources. In particular, they cite universities as organizations that produce basic research, as opposed to input suppliers, which usually possess knowledge targeted to firms needs. In line with the authors cited above, 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.

As described, distinct knowledge agents exert differential effects in terms of type of knowledge transferred, nature of the relationship and other factors which eventually have divergent implications on firm's learning and innovation (OCDE/Eurostat, 2005; Fey and Birkinshaw, 2005).

2.2.4 External knowledge search strategies

Applying March's (1991) dichotomy of exploration and exploitation the alliance literature has analyzed the distinct strategic nature involved in inter-firm collaborations. Koza and Lewin (1998) consider that the "purpose behind entering an exploration alliance involves the desire to discover new opportunities; while an exploitation alliance involves the joint maximization of assets" (p. 257). Empirical studies have approximated exploratory alliances to the function of R&D while exploitative alliances have been associated with manufacturing, marketing and other related functions (Rothaermel, 2001b; Park et al., 2002; Rothaermel and Deeds, 2004). For instance, Rothaermel and Deeds (2004) verify that different types of alliances are motivated by different goals and thus, achieve different outcomes.

In the same vein, some authors' approximate exploratory and exploitative strategies by considering the access to distinct knowledge agents. For instance, Faems et al. (2005) analyzes if collaborations are really relevant for improving existing competences and products as for creating new ones. For this they theorize and prove that universities and other scientific institutions are focused towards the development of new technologies, while agents such as suppliers and customers are characterized as optimizers of existing core competences. Also, Gilsing and Nooteboom (2006) consider that collaborations between biotechnology firms and

academic institutes are considered to involve high degree of learning and the transfer and pursuit of scientific knowledge.

Laursen and Salter (2006) also analyze distinct strategies in the context of external search through the use of distinct agents and their impact on innovation performance. These authors differentiate between breadth strategy, that is the number of different search channels that a firm draws upon in its innovative activities; and depth strategy, which is the extent to which firms draw intensively from different sources. Results show that searching widely and deeply take an inverted U shape in relation to innovation performance.

Through patent analysis Rosenkopf and Nerkar (2001) build a theoretical framework where distinct types of search are identified according to a two dimensional classification based on technological and organizational boundaries. In this theory, searching beyond the firms organizational boundaries follows two differentiated strategies, one, involving the search of distant knowledge and two searching for similar knowledge. Results show, first, that internal search processes inhibit technological evolution in contrast to those that span both organizational and technological boundaries. Second, that searches spanning only organizational boundaries cause the highest impact on technological evolution, while those spanning both boundaries have an impact on technological development beyond the optimal disk domain.

Building on a network perspective Ahuja (2000) finds that the configuration of inter-firm collaborations has an impact on firm's innovation results. In particular, the study identifies direct ties, indirect ties and structural holes as three dimensions characterizing the firm's ego structure and suggests their different roles in innovation processes. In this sense, the study looks for two objectives: one, evaluating the extent in which indirect ties might enjoy benefits of network size associated to

direct ties but at a lower cost, and two, understanding the implications concerned with closed and open network structures, thus evaluating the benefits of cohesiveness versus diversity in the network. Ahuja (2000) results show that both direct and indirect ties are predictors of innovation output, but that indirect ties are limited in magnitude and are contingent on the number of direct ties. They also find that as the number of structural holes increases innovation decreases, due to the lack of cohesiveness. Also, Shan, Walker and Kogut (1994) hypothesize and confirm that a startup's network position, in terms of embeddedness in the network, is positively associated with its number of relationships, which in turn has important implications for startup success. Similarly, Powell, Kogut and Smith (1996) argue that centrally located firms provide access to critical information and resource flows needed for internal growth.

2.2.5 External knowledge sourcing and internal knowledge generation

As already mentioned in the previous section, the goals in external knowledge search may be multiple. The external search for knowledge can be driven by the need to access new ideas, develop a broader knowledge base and acquire complementary assets as inputs in the firm's race towards innovation (Bierly and Daly, 2007). Also, working with external agents may foster the transfer of knowledge resulting in the generation of resources that would have been difficult to obtain without such interaction (Ahuja, 2000; Das and Teng, 2000). Other times firms are looking to reduce risks by sharing the costs of R&D with other agents (Miotti and Sachwald, 2003; Belderbos et al., 2004; Huang et al., 2009).

The dark side of interacting with external sources of knowledge has also been exposed, such as the promotion of learning races between partners (Larsson et al., 1998; Teece, 2002). Also, unintended knowledge spillovers and the weakening of organizational core technological competences have been underlined as relevant threats concerning external knowledge

(Coombs, 1996; Howells et al., 2003). In this line of thought, some authors have suggested that internal knowledge generation can be a better alternative (Vega-Jurado et al., 2008b; Vega-Jurado et al., 2009). For instance, these authors show that in-house R&D activities represent a strategic asset in the development of new products and, that developing these activities is more significant than external knowledge search.

Thus the evaluation of external knowledge sourcing risks and benefits is closely related to works dealing with the following question: external knowledge souricng or internal knowledge generation? These studies use the concepts of market and hierarchy developed in the Transaction Cost Theory, which suggests that firms are usually a better context than markets for transactions involving high asset specificity, uncertainty and opportunistic behavior (Williamson, 1985). Through this lens these studies analyze the risks and opportunities regarding the choice of sourcing external knowledge and performing R&D in-house activities (Croisier, 1998; Howells et al., 2003). Findings suggest that in the case of low uncertainty in technological knowledge and the presence of standard assets the costs related to external acquisition are lower than the firm's internal costs, making the former option preferable to the latter. In this sense, these studies conceptualize the question regarding whether the firm limits its resources to the internal boundaries of the firm or access the pool of knowledge available within the environment (Mowery, 1984; Vega-Jurado et al., 2009). That is, they conceptualize external knowledge sourcing and in-house knowledge generation as trade-offs.

After relevant critics made to the Transaction Costs Theory (for a review see Shelanski and Klein, 1995) the Resource Based View arises as an alternative powerful organizational theory, where the importance of internal resources as a source to competitive advantage is highlighted (Penrose, 1959; Wernefelt, 1984; Barney, 1991; Grant, 1991; Peteraf, 1993). In the context of external knowledge sourcing the Transaction Costs

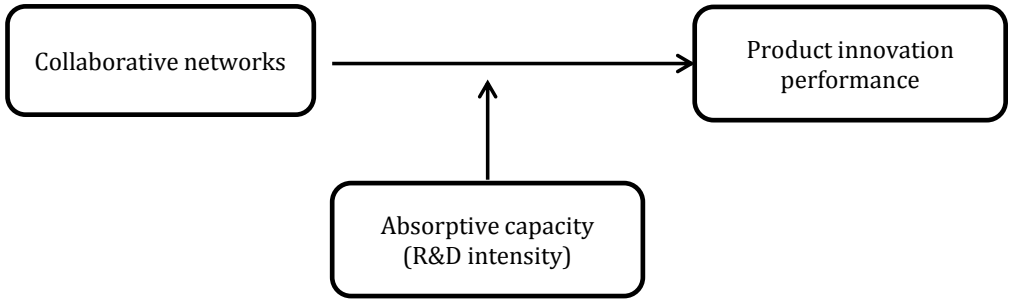
Theory was criticized because of its intensive focus on knowledge attributes (mainly uncertainty and specificity). On the other hand, studies which grounded their theoretical background on the Resource Based View started to offer additional insights, such as the role of firm's internal resources in shaping the firm's external search (Oerlemans and Meus, 2001). This idea was supported by evidence of cases in which firms outsourcing an important amount of their research and technical activity experienced the undermining of their internal capacity necessary to integrate the outsourced knowledge (Attuahene-Gima, 1992; Welch and Nayak, 1992). Also, in the case of cooperating, several authors have confirmed that cooperating with insufficient internal knowledge hampers the effective integration of knowledge (Vega-Jurado et al., 2009). This gives rise to the belief that external sourcing is not a substitute but a complement to in-house research activity (Coombs, 1996; Howells et al., 2003).

In this sense, absorptive capacity has emerged as a valuable conceptual approach, which recognizes that the organizations knowledge base is determinant in facilitating learning from external sources of knowledge (Cohen and Levinthal, 1990). Specifically, the original concept of absorptive capacity is defined as the firm's ability to use prior related knowledge to recognize, assimilate, and use external knowledge for commercial ends[7]. The interest of this concept and its influence over the last years is that it extends the traditional use of firm's internal knowledge as a generator of innovations to its role in taking advantage from external sources of knowledge.

However, studies considering the combined strategy concerning internal knowledge generation and external technology sourcing have produced mixed findings (See Figure 2.1 for an example of the common model tested within the studies in this tradition). In this sense, some authors have found that internal R&D and external knowledge acquisition are

complementary in affecting innovation performance (Miotti and Sachwald, 2003; Caloghirou et al., 2004; Cassiman and Veugelers, 2006; Tsai, 2009; Tsai and Wang, 2009; Sofka and Grimpe, 2010) while other scholars find a substitution effect between internal and external knowledge sourcing (Laursen and Salter, 2006; Haro-Domínguez et al., 2007; Vega-Jurado et al., 2009).

Figure 2.1 R&D intensity moderating effect on collaborative networks and product innovation performance



Source: Adapted from Tsai, 2009

We argue that these contradictory findings could be resolved by a richer interpretation of absorptive capacity theoretical framework. Even though the seminal paper of Cohen and Levinthal (1990) measures absorptive capacity through the proxy variable of R&D expenditures, their theoretical framework was much more extensive. Cohen and Levinthal (1990) highlight that absorptive capacity, "will depend on the absorptive capacities of its individual members but it is not the sum of the absorptive capacities of its employees" remarking the necessity of considering "what aspects of absorptive capacity are distinctly organizational" (p.131)[8].

However, most of the studies in this tradition follow Cohen and Levinthal's (1990) modus operandis and focus on internal knowledge content, primarily technological knowledge, considering firms in-house R&D efforts as the main indicator of absorptive capacity. Recently, Koka et

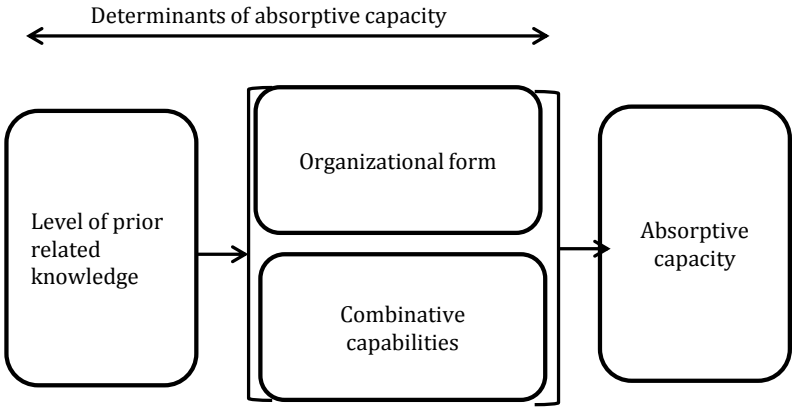
al. (2006) and McMillan (2008) warn about the problems caused by limiting absorptive capacity concept to knowledge content and neglecting the central role of management in this process. In our view studies in the innovation economic approach have definitely neglected the important role of organizational factors in the process of sourcing and exploiting external knowledge.

However, recently a few exceptions have made an effort in measuring the determinants of organizational absorptive capacity (Van den Bosch et al., 1999; Jansen et al., 2005; Vega-Jurado et al., 2008a; Foss et al., 2010; Schmidt et al., 2010; Gebauer et al., 2012). In the following section we will describe in detail these studies.

2.3 KEY STUDIES

Van den Bosch et al. (1999) establish a framework in which they posit both the level of prior related knowledge and organizational factors as important antecedents of absorptive capacity. They focus on the firm's organizational form and their combinative capabilities. The former is defined as the methods for grouping activities, number of hierarchical levels and the extent to which management is divided into various functional levels (that is functional, divisional, or matrix organizational structure), while the latter is defined as the capabilities, which synthesize and apply current and acquired knowledge (that is, systems, coordination and socialization capabilities)[9]. In general terms, these authors argue that the firm's organizational structure and combinative capabilities influence the assimilation of external knowledge (See figure 2.2 as a synthesis of their theoretical framework).

Figure 2.2 Organizational form and combinative capabilities as determinants of absorptive capacity



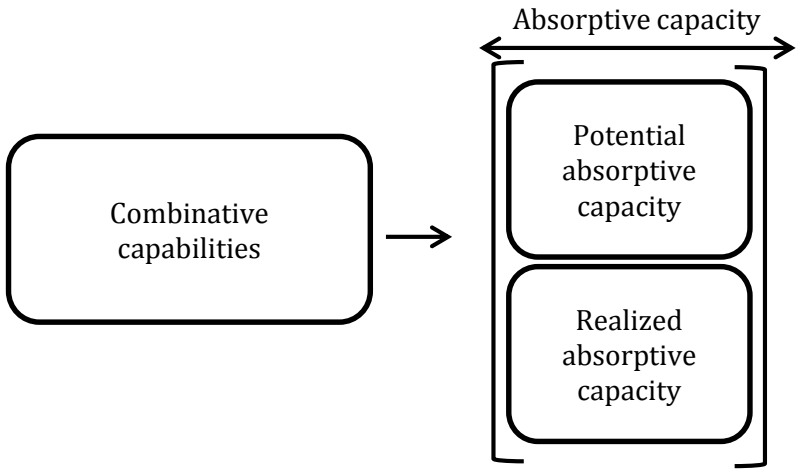
Source: Adapted from Van den Bosch et al., 1999

Specifically, they argue that the functional form exerts a negative effect on absorptive capacity, while the divisional and matrix form exert a moderate and a positive effect respectively. In relation to combinative capabilities, they argue that systems and socialization capabilities exert a negative effect on absorptive capacity, and coordination capabilities exert a positive effect[10]. They prove these initial assumptions in two longitudinal case studies of traditional publishing firms moving into the turbulent knowledge environment of an emerging multimedia industrial complex[11]. Results show that a change from functional to innovative structure, in the first study, and from functional to matrix, in the second study, positively influenced the impact of prior related knowledge on absorptive capacity. In the case of combinative capabilities, results on both cases show that, contrary to the initial assumptions, not only coordination capabilities positively affected absorptive capacity but also systems capabilities.

Building on Van den Bosch et al. (1999), Jansen et al. (2005) deepen into the idea of combinative capabilities by suggesting specific organizational mechanisms as common features of combinative capabilities. In this sense, coordination capabilities are proxied through cross-functional interfaces, participation in decision making, and job rotation; systems capabilities as

formalization and routinization mechanisms; and socialization capabilities as connectedness and socialization tactics[12]. This allows the authors to test their hypothesis on a large-scale empirical study concerning a multi-unit financial services firm (769 business units). Moreover, these authors build on a process view of absorptive capacity developed by Zahra and George (2002) and empirically test the effect of organizational mechanisms in two components of the absorptive capacity concept: on the one hand, the firm's capacity to acquire and assimilate external knowledge (potential absorptive capacity-PACAP-) and on the other hand, the firm's capacity to transform and exploit this knowledge (realized absorptive capacity-RACAP) [13] (See figure 2.3). Results demonstrate distinct effects of the organizational mechanisms in potential and realized absorptive capacity [14].

Figure 2.3 Combinative capabilities as determinants of potential and realized absorptive capacity

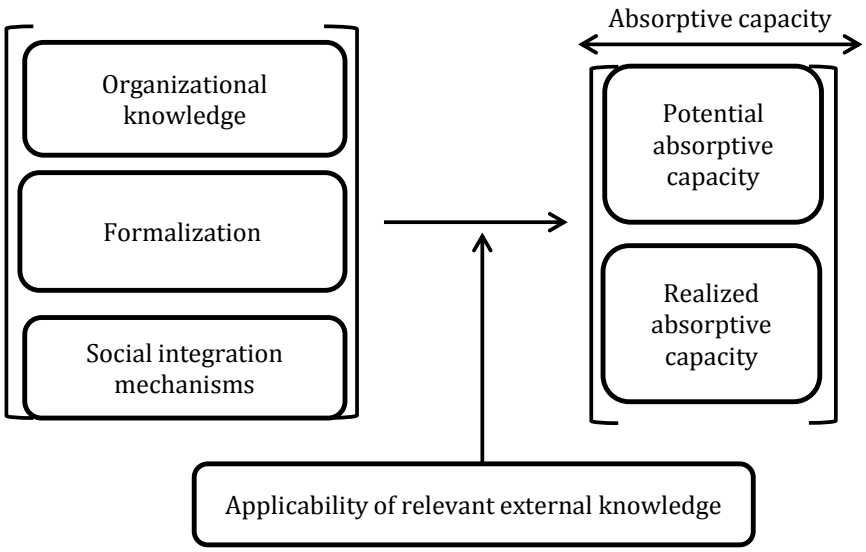


Source: Adapted from Jansen et al., 2005

Other empirical studies have followed the approach of Van den Bosch et al. (1999) and Jansen et al. (2005). For instance, recently, Vega-Jurado et al. (2008a) propose that the firm's absorptive capacity in their both dimensions, PACAP and RACAP, is not only influenced by knowledge

content but by the routines and processes within the organization. The former is conceptualized in terms of R&D and the latter as social integration mechanisms (SIM) and formalization. This study in 84 firms in belonging to two industrial districts shows that not only R&D but also the firm's organizational dimension is relevant antecedents of absorptive capacity and that certain mechanisms are more effective in generating PACAP than RACAP and the other way around. Moreover, these authors enrich prior studies by distinguishing between scientific and industrial PACAP and RACAP[15]. In their theoretical model, they differentiate these types of knowledge in terms of applicability degree to the firm's knowledge base (See figure 2.4). Results show that absorptive capacity is contingent on the type of organizational mechanism and the type of absorptive capacity[16].

Figure 2.4 The role of external knowledge applicability in the creation of absorptive capacity



Source: Adapted from Vega-Jurado et al., 2008a

Schmidt (2010) empirically analyzes the effect of R&D and related activities, and the firm's organization in relation to knowledge sharing, that is incentives and actual knowledge transfer, on firm's absorptive capacity. In this study, similarly to Vega-Jurado et al. (2008a), the authors

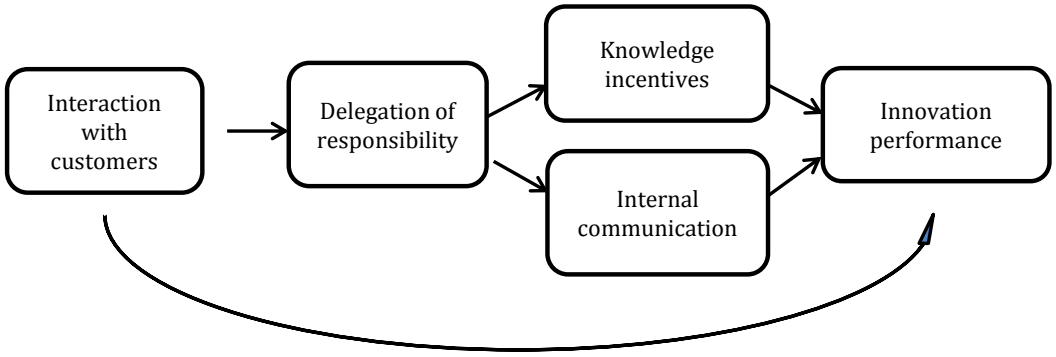
classify absorptive capacity into three types: absorptive capacity for firms own industry knowledge, knowledge from other industries and knowledge from research institutions. They focus on innovative firms from services and manufacturing sectors and results show that collaboration between departments has an impact on absorptive capacity, but only in the case of informal contacts. This suggests that it is more important to create a culture leading to informal knowledge transfer instead of a culture in which information provision is more centralized. Also, stimulating employee participation in innovation activities is positively associated with absorptive capacity. In the case of collaboration among departments the effect is significant for intra-industry and scientific absorptive capacity[17]. Incentives for acquiring knowledge in the innovation process exerted a positive and significant influence for the three kinds of absorptive capacity.

More recently, Gebauer et al. (2012) pursued a similar study to that of Van den Bosch et al. (1999) by analyzing in depth two electricity providers[18]. Influenced by the study of Jansen et al. (2005) and Lichtenthaler (2009) – the latter associates PACAP and RACAP to exploratory and exploitative learning processes-, these authors found that exploratory and transformative learning processes benefit from changes in coordination capabilities, while exploitative learning processes take advantage from strong formalization and routinization.

In a different line, Foss et al. (2010) uses absorptive capacity concept as a theoretical framework but does not attempt to measure it directly. The authors establish a very interesting relationship studying a specific case of external knowledge sourcing: the study of the customer as an external source. Similarly to Vega-Jurado et al. (2008a) and Schmidt (2010) they posit that the nature of the agent involved in the sourcing of knowledge is central to the flow of knowledge within the organization. Foss et al. (2010) posit that if personnel in R&D interact directly with key users then there is

a direct link and no organizational parameters are necessary to leverage this knowledge; however there is a necessity of organizational mechanisms when the knowledge provided by the customer is not directly entering R&D department (See figure 2.5 which shows the theoretical framework). Their results on a sample of 169 firms from different industries show that there is a mediating effect of delegation of decision rights, internal communication and incentive systems between acquisition of customers knowledge and innovation performance.

Figure 2.5 The mediating role of organizational factors between customers interactions and innovation performance



Source: Adapted from Foss et al., 2010

Table 2.1 summarizes the main features of the studies described above. In this table one can observe distinct units of analysis and methodologies; different approaches in conceptualizing absorptive capacity and differences in its measurement. Also, the table shows different organizational factors understood as the firm's organizational dimension and distinct measurements employed.

Table 2.1 Summary of studies integrating the organizational dimension into the analysis

Authors	Unit of analysis	Method	Conceptualization and measurement of absorptive capacity (AC)
Van den Bosch et al. (1999)	2 firms	Case studies	Organizational absorptive capacity (scope, flexibility and efficiency)
Jansen et al. (2005)	769 units	Surveys	Potential and realized unit absorptive capacity (PACAP and RACAP) Multi-item measurement of four dimensions: acquisition, assimilation, transformation and exploitation
Vega-Jurado et al. (2008a)	84 firms	Surveys	Potential and realized organizational absorptive capacity (scientific PACAP and RACAP; industrial PACAP and RACAP) Operationalization based on CIS (Community Innovation Survey)*
Schimdt (2010)	2000 firms	Surveys	Organizational absorptive capacity (intra-industry AC; inter-industry AC; scientific AC) Operationalization based on CIS
Foss et al. (2010)	169 firms	Surveys	Uses absorptive capacity as a theoretical framework, but does not conceptualize nor measure it directly
Gebauer et al. (2012)	2 firms	Case studies	Organizational absorptive capacity (exploratory learning; assimilative and transformative learning; exploitative learning)

*Vega-Jurado et al. (2008a) and Schmidt et al. (2010) use a similar strategy to the CIS to capture the acquisition and exploitation of external knowledge.

The first concept reflects the firm's use of knowledge sources as an indication of the firm's capacity to acquire external knowledge and the second concept reflects the extent to which firms have used knowledge sources to develop innovations indicating its exploitation capacity.

Source: Authors' elaboration

Table 2.1 (continued)

Authors	Organizational factors*							
Van den Bosch et al. (1999)	Coordination capabilities			Systems capabilities		Socialization capabilities		
Jansen et al. (2005)	Cross functional interfaces	Decentralization	Job rotation	Formalization	Routinization	Connectedness	Socialization tactics	
Vega-Jurado et al. (2008a)	S.I.M.		S.I.M.	Formalization				
Schimdt (2010)	Knowledge-sharing							
Foss et al. (2010)	Cross functional interfaces	Decentralization						Incentives
Gebauer (2012)	Coordination capabilities			Syatems capabilities		Socialization capabilities		

*The measurement of the constructs varies according to the different authors. For instance, Jansen et al. (2005) measure formalization by using a multi-item measurement while Vega-Jurado et al. (2008a) approximate formalization by calculating the average of the following items: technology watch system, training program and ISO 9000 certificate.

Source: Authors' elaboration

2.4 CONCLUSION

Thus, the studies integrating organizational factors into the analysis of external knowledge sourcing and innovation are few and very different in both theoretical and empirical levels. However, they provide relevant insights to the extensive number of studies in the economic approach that partially understand the search of external knowledge and its effect on innovation by focusing on the role of internal technological capacities, and neglecting the role of organizational factors on this aspect.

In this thesis we will analyze in depth the studies of these authors and add further insights to this stream of the literature by deepening into the study of organizational structure from the organizational design perspective of management literature. Plus, we will draw on organizational learning scholars to further understand the role of exploration and exploitation in this process.

Chapter 3:

Insights from organizational design and organizational learning literatures. Development of the hypotheses

3.1 INTRODUCTION

The aim of this chapter is to review studies anchored in the management perspective to enrich those dealing with external knowledge search and innovation. First, organizational design and organizational learning literatures will be presented to aid us in the development of our theoretical arguments. Lately, studies on organizational learning have become very popular and abundant, being especially relevant to explain our research questions. This literature has paid attention to the learning processes behind innovation, especially to learning and innovating trajectories characterized through the terms of exploration and exploitation. In general, studies in this tradition focus on internal knowledge management paying little attention to external knowledge that can be equally as relevant in the achievement of innovations. We review this research whose lessons are used to guide our analysis with respect to our two main research questions: one referring to the influence of

organizational structure on external search strategy and the second referring to its role in the effect of external search on firm's types of innovation.

Thus, this chapter adopts the following form. In Section 3.2 we will describe the firm's formal structure and deepen into organizational learning studies analyzing the effects of structure on exploratory and exploitative innovation. In Section 3.3 we will extend this literature, traditionally constrained to firm's boundaries, by analyzing inter-firm relationships. Sections 3.4 and 3.5 develop the hypotheses in relation to the role of organizational structure on external search strategy and its moderating effect between external search and innovation results. Section 3.6 concludes.

3.2 THE FIRM'S FORMAL STRUCTURE

3.2.1 Conceptualizations of firm's formal structure

The classical theory on organizational design hearkens back to the 40's (Weber, 1947; Burns and Stalker, 1994) however, over the last two decades literature on organizational forms has flourished. For instance, new organizational forms literature has become popular, thus reflecting the renewed interest in understanding different design choices (Djelic and Ainamo, 1999; Lewin et al., 1999; Child and McGrath, 2001; Lampel and Shamsie, 2003; Schreyogg and Sydow, 2010). As literature has burgeoned different labels have been used to describe the organizational dimension of the firm. Some authors use organizational structure, design, architecture, forms and even practices indiscriminately. Damanpour (1991) through a meta-analysis identified thirteen organizational attributes including mainly structural variables, but also process, resource, and cultural variables.

We follow the Carnegie tradition, which understands organizational structure as 'the pattern of communications and relations among a group of human beings' (Simon, 1947:18-19; Csaszar, 2012). Among the various conceptualizations of organizational structure, we focus on two specific dimensions that respond to the formal side of structure: the formalization of organizational processes and decentralization of decision-making (Jansen et al., 2006). Formalization describes the degree to which organizational behaviors are governed by formal rules and procedures (Khandwalla, 1977); decentralization refers to the extent to which the locus of authority and decision-making extends down the organizational hierarchy (Damanpour, 1991).

3.2.2 The firm's formal structure and its effect on innovation: focusing on exploratory and exploitative innovation

Studies in this tradition have suggested that specific organizational configurations are more suitable for managing knowledge and learning, and pursuing innovation results (Damanpour, 1991; Jansen et al., 2006; Menguc and Auh, 2010). For instance, organizational learning theory proposes that the organizational dimension of the firm is fundamental for achieving significant innovation results. Research in this area highlights that organizational features lie behind the learning processes through which knowledge is created, integrated and utilized (Hult et al., 2004; Alegre and Chiva, 2008). Studies in the field of knowledge management also recognize that organizational contexts may generate the conditions that facilitate or hinder the transition between knowledge management and new product generation (Chen et al., 2010). Studies in the field of organizational innovation also recognize that certain organizational characteristics may facilitate or hinder innovation, even affecting its degree of radicalness (López-Cabrales et al., 2008).

Past research has highlighted that discriminating between types of

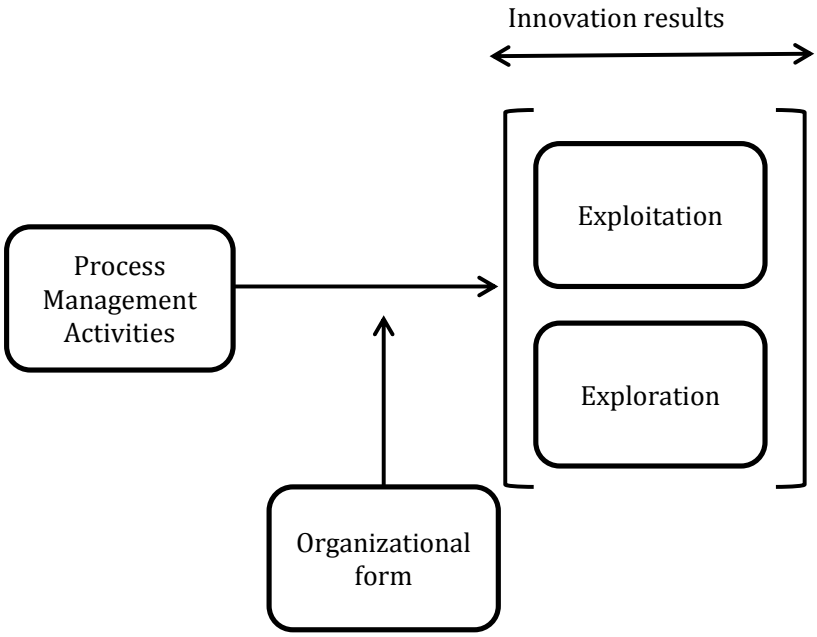
innovation is necessary for understanding the determinants of organizations' adoption behavior (Knight, 1967; Rowe and Boise, 1974; Downs and Mohr, 1976; Damanpour, 1991). These studies often propose typologies of innovation. The most common differentiation is between product and process innovation (Damanpour, 1991; OECD-Eurostat, 2005). Other commonly used categorizations have been: administrative and technical innovation, and radical and incremental innovation. Also, following March's (1991) seminal piece in organizational learning tradition, exploratory and exploitative innovations have been used to capture types of innovative results (Benner and Tushman, 2002; Jansen et al., 2006)[1]. Figure 3.1 shows the theoretical framework proposed by Benner and Tushman (2002), which captures innovation through the exploitation and exploration categorization.

Specifically, studies in this tradition have continuously described formalization and decentralization as opposing forces defining organizational structure; where the former satisfies better the development of exploitative activities and the latter fits better exploratory purposes (Brown and Eisenhardt, 1997; Nickerson and Zenger, 2002; Siggelkow and Levithal, 2003; Jansen et al., 2006; Lavie and Rosenkopf, 2006; Chang and Hugues, 2012).

Formalized practices, through codification, make knowledge explicit and reinforce work processes. In this sense, the behavior of participants becomes predictable, that is, employees know what to do and they react very quickly (Khandwalla, 1977). Formalization also facilitates the efficient execution of tasks such as faster decision-making (Kogut and Zander, 1992; Jansen et al., 2006). In this sense, codification has been said to be potentially important as a supporting mechanism for the entire knowledge evolution process (Zollo and Winter, 2002). In the words of these authors, formalization can "facilitate the generation of new proposals to change the currently available routines, as well as the identification of the strengths

and the weaknesses in the proposed variations to the current set of routines" (p. 342).

Figure 3.1 Process Management and organizational form effects on exploratory and exploitative innovation results



Source: Adapted from Benner and Tushman , 2002

However, with time, formalization can be transformed into established routines, inhibiting the spontaneity, creativity, risk-taking, flexibility and experimentation among employees needed for knowledge creation (Bidault and Cummings, 1994; Menguc and Auh, 2010). For instance, Benner and Tushman (2003) argue that process management practices (i.e. TQM, ISO 9000 or Six Sigma) as types of formalization, generate organizational inflexibility, reducing the firm's capabilities for experimentation. Also, as organizations increasingly program tasks, employees feel less inclined to upgrade their existing knowledge and to create new knowledge (Willem and Buelens, 2009). In general, formalization focuses on the leverage of existing knowledge but inhibits the creation of new knowledge and the pursuit of exploratory innovations (Benner and Tushman, 2002/2003; Jansen et al., 2006).

On the contrary, decentralization of decision-making enhances exploratory innovation (Jansen et al., 2006). Decentralized structure promotes autonomous decision-making and the capability of generating new ideas and discovering new solutions (Cohen and Levinthal, 1990, Jansen et al., 2006; Menguc and Auh, 2010). Moreover, providing employees with autonomy to make their own decisions contributes in a positive manner to the creation of a participatory work environment, which enhances organizational members' awareness, commitment and involvement in the creation of new knowledge (Damanpour, 1991; Chen and Lin, 2004; Song et al., 2005).

In fact, decentralization has been associated with the acceptance of more projects, fewer omission errors and more commission errors (Csaszar, 2012). Avoiding omission errors could constraint exploration, in Bill Gates words 'the real sin is if we (Micrososft's R&D) miss something' (Hawn, 2004:70) while this will be a current practice in firm's looking for exploitation, in the case of Procter and Gamble new products proposals were reviewed more than 40 times before reaching the CEO (Herbold, 2002; Csaszar, 2012).

3.3 THE ROLE OF FORMAL STRUCTURE IN EXTERNAL KNOWLEDGE SOURCING AND UTILIZATION

3.3.1 Main results on formalization of organizational processes and decentralization of decision-making

Most of the previous research focuses on how firms can leverage their internal knowledge, but disregards the influence of formal structure in the configuration of external knowledge sourcing processes. In the present chapter we place particular emphasis on understanding to what extent the effect of structure varies in the particular case of external knowledge sourcing.

As already mentioned in the previous chapter, only a few studies in the absorptive capacity literature (Van den Bosch et al., 1999; Jansen et al., 2005; Vega-Jurado et al., 2008a; Foss et al., 2010; Schimdt , 2010; Gebauer et al., 2012) have tried to approach the issue concerning the impact of organizational factors on the sourcing and exploitation of external knowledge. However, these studies differ in methods, approaches and conceptualizations towards the definition of "organizational".

In this thesis we prefer to go back to organizational design literature and focus on two main dimensions of organizational structure: formalization and decentralization. From the studies above, only three analyze the effect of formalization and decentralization on external knowledge sourcing processes (Jansen et al., 2005; Vega-Jurado et al., 2008a; Foss et al., 2010). Table 3.1 and 3.2 summarizes the results according to these two variables. In the following lines we detail the main findings.

Concerning formalization, Jansen et al. (2005) hypothesized that formalization exerted a negative effect on the acquisition and assimilation of external knowledge (PACAP) and a positive effect on the transformation and exploitation of external knowledge (RACAP). They argued that formalization facilitated knowledge exchange through its efficacy in setting clear procedures but that it could also inhibit knowledge flows through the creation of rigidities within the organization and the inability to reorganize and react to changing environmental conditions. In this sense, the first argument being especially relevant for RACAP and the second for PACAP. Results confirm that formalization exerted a positive effect on RACAP (specifically on transformation and exploitation dimensions). In this sense, formalization enhances the effectiveness of external knowledge transformation and utilization through the codification of knowledge flows.

According to Vega's thesis, formalization increases firms PACAP by

laying down general guidelines. Moreover, in their analysis of different kinds of external sources involved in the process, they argue that partnering with scientific agents creates potential barriers of communication. In other words if knowledge is more distant from that of the firm's knowledge base there is a higher necessity of establishing procedures facilitating communication. In the opposite case, industrial knowledge, which is more related to that of the firm's knowledge base, does not need dedicated channels for communication. Their results verify the positive effect of formalization in the absorption of external knowledge and further show that this effect is enhanced when considering scientific agents (PACAP and scientific PACAP). Moreover, even though they do not formulate an explicit hypothesis in relation to the effect of formalization in the transformation and exploitation of external knowledge their results show a significant positive effect only when considering scientific agents (scientific RACAP). In this sense, the results show that the existence of norms and procedures does not only favor the acquisition and assimilation of scientific knowledge but also its transformation and exploitation.

In relation to decentralization of decision making, Jansen et al. (2005) hypothesize a positive effect on PACAP and a negative effect on RACAP. Their arguments support that employees become more open to external knowledge as they are empowered with decision making but can slow down the transformation and exploitation of external knowledge because of the higher difficulty in gaining consensus. The results confirm partially the positive effect on PACAP (only for acquisition) and the second relationship (only the transformation dimension). These results suggest that exploitation requires more stable and densely connected knowledge structures than does transformation. The study of Foss et al. (2010) also shows that decentralization is relevant in transforming external customer's knowledge into innovation results.

These studies proportionate some insights into the thesis research questions. In relation to the first question of our thesis: how organizational structure affects external knowledge search, these studies seem to convey a positive effect. In relation to the second question of our thesis, what is the effect of structure on the effectiveness of external knowledge exploitation? These studies seem to be indicating also a positive effect of structure on the effectiveness of external knowledge exploitation. However, the empirical evidence is still scarce and heterogeneous. In this sense, more evidence is needed. This thesis will contribute in this direction.

3.3.2 The contingent role of exploration and exploitation

The definition of exploration and exploitation has not been always equal. There are studies understanding exploration and exploitation as learning and innovation but of different kinds (Baum et al., 2000b; Benner and Tushman, 2002; He and Wong, 2004) and other studies that employ exploitation only to refer to the exploitation of past or existing knowledge (Rosenkopf and Nerkar, 2001; Vermeulen and Barkema, 2001; Vassolo et al., 2004). To avoid adding to the present terminology confusion our approach focuses on the former view in which both exploration and exploitation are activities involving learning (Gupta et al., 2006). This approach is in line with March (1991) conceptualization in which "the essence of exploitation is the refinement and extension of existing competencies, technologies and paradigms…, whereas the essence of exploration is experimentation with new alternatives" (p.85). In other words, exploitation refers to whether the new learning occurs along the same trajectory as the old learning while exploration refers to whether learning occurs along an entirely different one (Gupta et al., 2006).

Also, exploration and exploitation have been interpreted from two different viewpoints: from an innovation process and from an innovative

outcome viewpoint (Li et al., 2008). Some studies relate exploration and exploitation directly to innovative outcomes that is, to products or services (Dowell and Swaminathan, 2006; Jansen et al., 2006; Greve, 2007). For example Greve (2007) measure exploration as the number of innovations that involve the development of new technology 'new to the firm', and exploitation as all other types of innovations. Similarly, in a study on the bicycle industry, Dowell and Swaminathan (2006) identify four types of bicycles in history in which exploration is measured by the number of types of bicycle introduced by a firm before it finally introduces the most modern type. Jansen et al. (2006) also measure exploration and exploitation as an innovative outcome by the use of a multi-item scale.

On the other hand, the strand of research dealing with innovation process, has focused in applying the concept to learning activities, behavior, investment and strategies (i.e. Jayanthi and Sinha, 1998; Nerkar, 2003; He and Wong, 2004; Nerkar and Roberts, 2004; Van Looy et al., 2005; Phene et al., 2006; Sidhu et al., 2007). Focusing on the latter, studies based on technology search literature mainly use patent data to understand the degree of knowledge distance (e.g. Argyres, 1996; Katila and Ahuja, 2002; Nerkar and Roberts, 2004). Moreover, studies focused on the search for market knowledge usually make use of multi-item measures (McGrath, 2001; Sidhu et al., 2004; Sidhu et al., 2007). Also studies examining alliances and other types of collaborations use upstream and downstream partners as a means of measuring exploration and exploitation (Rothaermel, 2001a; Vassolo et al., 2004; Gilsing and Nootemboom, 2006).

In our view both strands of research are intimately related. Exploratory and exploitative innovation is an outcome of the decision-making process in relation to search. So, in configuring the firm's external search strategy the deciding agents are already expecting an outcome in line with the strategy. This line of thought leads us to conceptualize exploration and exploitation in two differentiated levels: exploratory and exploitative

search, as a process aimed to the acquisition of external knowledge, and exploratory and exploitative innovation as a result of firm's innovation efforts.

Table 3.1 State of the art. Results of formalization effects on acquisition and exploitation of external knowledge

	Hypotheses	Results
Acquisition and assimilation of external knowledge		
Jansen et al. (2005)*	Negative	Non-significant (acquisition and assimilation)
Vega-Jurado et al. (2008a)**	Positive (especially for S.A.)	Positive (positive for S.A.; non-significant for I.A.)
Foss et al. (2010)	Absent in the analysis	Absent in the analysis
Transformation and exploitation of external knowledge		
Jansen et al. (2005)	Positive	Positive (transformation and exploitation)
Vega-Jurado et al. (2008a)	No hypothesis	Non-significant (positive for S.A.; non-significant for I.A.)
Foss et al. (2010)	Absent in the analysis	Absent in the analysis

*In their results these authors distinguish between the two different dimensions of PACAP (acquisition and assimilation) and RACAP (transformation and exploitation). Information in brackets shows the detailed results.
**Vega-Jurado et al. (2008a) show general results in relation to PACAP and discriminate by distinct types of agents. S.A. stands for scientific agents and I.A. for industrial agents.

Source: Authors' elaboration

Table 3.2 State of the art. Results of decentralization effects on acquisition and exploitation of external knowledge

	Hypotheses	Results
Acquisition and assimilation of external knowledge		
Jansen et al. (2005)	Positive	Partially positive (only for acquisition)
Vega-Jurado et al. (2008a)	Absent in the analysis	Absent in the analysis
Foss et al. (2010)*	Absent in the analysis	Absent in the analysis
Transformation and exploitation of external knowledge		
Jansen et al. (2005)	Negative	Non-significant (only for transformation)
Vega-Jurado et al. (2008a)	Absent in the analysis	Absent in the analysis
Foss et al. (2010)	Positive	Positive (more related to transformation because of mediation)

* These authors focus their study on one external agent: customer. Moreover, in their analysis Foss et al. (2010) use mediations in structural equation modeling, which it's more close to the transformation dimension of absorptive capacity.

Source: Authors' elaboration

3.4 THE FORMAL STRUCTURE AND OTHER FACTORS AS DETERMINANTS OF EXTERNAL KNOWLEDGE SEARCH STRATEGY

3.4.1 State of the art. The determinants of external knowledge search strategy

Until now the literature emphasizes environmental context and technological resources, especially R&D, as important determinants of the search strategy. Alliance research has focused on identifying industry conditions that demonstrate tendencies to pursue distinct strategies (Rothaermel, 2001a; Park et al., 2002; Beckman et al., 2004). Specifically, Park et al. (2002) goes beyond environmental factors and underlines the relevance of firm's resource endowments in entering exploitative and exploratory alliances. From an information-process perspective, the study of Sidhu et al. (2004) also highlights both environmental factors and managerial intentions as determinants of exploratory information acquisition. However, still, the question remains open when deepening into the specific organizational structures influencing the firm's responses towards an exploitative or exploratory oriented external search.

We argue that industrial conditions and technological resources are not enough to explain the strategy involving the search of external knowledge and that organizational configuration should be taken into consideration. Specifically we will contribute to the extant literature by formulating the following research question: To what extent does structure influence the external search strategy?

3.4.2 Understanding exploratory and exploitative search strategies

As we can recall, exploration and exploitation can be understood both as a process and outcome. Specifically, in this section we will focus on studies

that conceptualize exploration and exploitation as differentiated strategies (i.e. Argyres, 1996; McGrath, 2001; Rothaermel, 2001a; Katila and Ahuja, 2002; Nerkar and Roberts, 2004; Sidhu et al., 2004; Vassolo et al., 2004; Gilsing and Nooteboom, 2006; Sidhu et al., 2007)

In the specific context of external search, exploitation involves the use of new knowledge that is in the neighborhood of firm's prior knowledge base. Thus, searching within closely related technological domains has been associated with incremental learning that gradually expands the firm's current knowledge base. By searching within local domains the firm improves its current expertise and excels in the exploitation of related knowledge (Bierly and Chakbarti, 1996; Rosenkopf and Nerkar, 2001). Moreover, this knowledge requires fewer efforts associated with the generation of absorptive capacities (Cohen and Levinthal, 1990) and entails benefits, which are manifested in the short term (March, 1991). However, targeting search towards close technological domains can drag firms to situations where the firm's expertise becomes obsolete and no longer attractive to customers' expectations (March, 1991; Bierly and Daly, 2007).

In the case of exploratory external search, the pursuit of knowledge that differs from that of the firm's knowledge stock is implied. The pursuit of distant knowledge supplies the firm with complementary knowledge and information creating variety and heterogeneity in problem solving (Koza and Lewin, 1998). Firms involved in more exploratory search have more opportunities of experimenting radical learning and reaching novel solutions that challenge current understandings, which enhance firm's possibilities of surviving in the long-term (March, 1991). However, an exploratory strategy involves managing unfamiliar knowledge and skills, which can include high costs of experimentation and increased risk for a firm (Bierly and Daly, 2007).

3.4.3 The formal structure as a determinant of exploratory and exploitative search strategies. Development of hypotheses

The absorptive capacity literature suggests that the design of the organizational structure influences the firm's external knowledge sourcing. Most of these studies have suggested different levels of 'integration' or 'combination' depending on the organizational structure. Organizational structures characterized by formalized processes codify and integrates pieces of knowledge, and provide guides and instructions that facilitate the management of routine activities including the absorption of external knowledge (Van den Bosch et al., 1999; Jansen et al., 2005; Vega-Jurado et al., 2008a). Jansen et al. (2005) first hypothesize a negative relationship of formalization on acquisition and assimilation of external knowledge arguing that formalization hinders rich, reciprocal knowledge interaction, but later, obtain non-significant result. On the other hand, Vega-Jurado et al. (2008a) theorized and empirically verified the positive effect of formalization in the absorption of external knowledge.

Similarly, decentralized processes for making and implementing decisions facilitate external knowledge acquisition. Decentralized processes for making and implementing decisions results in a diversified knowledge base that facilitates knowledge acquisition (Cohen and Levinthal, 1990). Diverse knowledge increases the possibility that the new knowledge will complement existing knowledge and increases the number of potential receptors of this knowledge, promoting more external knowledge search (Zhang et al., 2007). The only empirical study that tests this relationship verifies that decentralization of decision making fosters flows of knowledge and thus, the presence of greater flexibility in the absorption of external knowledge (Jansen et al., 2005).

Thus, in line with studies in the absorptive capacity literature it seems that formalization and decentralization of organizational processes facilitates external knowledge sourcing. Both mechanisms promote integration and synthesis of new knowledge (Jansen et al., 2005; Vega-Jurado et al., 2008a).

Nevertheless, we argue that these findings could be contingent on the type of external search strategy performed by the firm. From the organizational learning tradition, we learn that formalization usually fosters exploitative processes while decentralization generates exploratory based activities (Benner and Tushman, 2002/2003; Jansen et al., 2006). Extending this thought to external knowledge search, we argue that formalization of organizational processes constraints exploratory searches and that decentralization increases the probability of pursuing this type of search.

Formalization puts in place procedures that with time can become inflexible routines. Thus, employees become more focused on the existent processes within the organization and limit their search for knowledge which is in the neighborhood of their knowledge base. In this sense, highly formalized procedures anchors firm's search in known domains and deters the search for unfamiliar solutions. On the other hand, decentralization has the characteristic of bestowing autonomy to employees, increasing the potential for new ideas creation. In this process, decentralization generates the conditions to search for novel solutions, increasing the probability of an exploratory strategy. We hypothesize that:

H1: Formalization of organizational processes will decrease the probability of pursuing an exploratory oriented external search strategy.

H2: Decentralization of decision-making will increase the probability of pursuing an exploratory oriented external search strategy.

3.4.4 Other relevant determinants

External pressures have been found to exert an influence on an organization's actions towards exploratory and exploitative search. In studying whether firms pursue exploratory or exploitative search, some research has highlighted environmental conditions as important antecedents (Park et al., 2002; Dias and Magriço, 2012). Specifically, Park et al. (2002) study market changes, specifically, growing and declining markets, as one of the primary drivers of exploratory and exploitative strategic alliances[2]. These authors also suggest that in future studies scholars should include more environmental dimensions and analyze their different effects.

Listening to this advice we study two dimensions of the environmental context: dynamism and competitiveness (Sidhu et al., 2004; Jansen et al., 2006; Sidhu et al., 2007). Environmental dynamism can be defined as the rate of change and the degree of unpredictability of environmental change (Dess and Beard, 1984); environmental competitiveness can be defined as the extent to which environmental contexts are characterized by intense competition (Matusik and Hill, 1998).

High levels of dynamism are characterized by high uncertainty involving rapid technological changes and rapid variation in customer preferences (Jansen et al., 2006). Dynamic environments increase the risk of product obsolescence, which could be avoided through the introduction of new products and services (Sidhu et al., 2004; Song et al., 2005). Thus, in dynamic environments exploratory knowledge search allows firms to experiment with new technologies and increases the chances of achieving new products and services that satisfy emerging customer demand. In dynamic environments, pursuing an exploitative search strategy will result in products that are based on existing knowledge which fail to satisfy new technological and customer preferences. We would expect a

dynamic environment to promote implementation of an exploratory search strategy. Thus, we hypothesize that:

H3. Environmental dynamism will increase the probability that firms will pursue an exploratory oriented external search strategy.

Competition pushes the firm to be more efficient and to lower its prices. Smaller profit margins provide less opportunity for investment in risky projects (Jansen et al., 2006). Thus, competition inhibits the conduction of risky exploratory search strategies and, contrastingly, is more appropriate for strategies based on the search for local knowledge, which allows the firm to modify or expand current products and services at a lower risk. Thus, competition promotes more local, less costly search, and more exploitative innovations. Higher levels of competition promote exploitative search to extend current expertise and allow rapid introduction of improved products and services. Thus, we hypothesize that:

H4. Increased competition will decrease the probability of pursuing an exploratory oriented external search strategy.

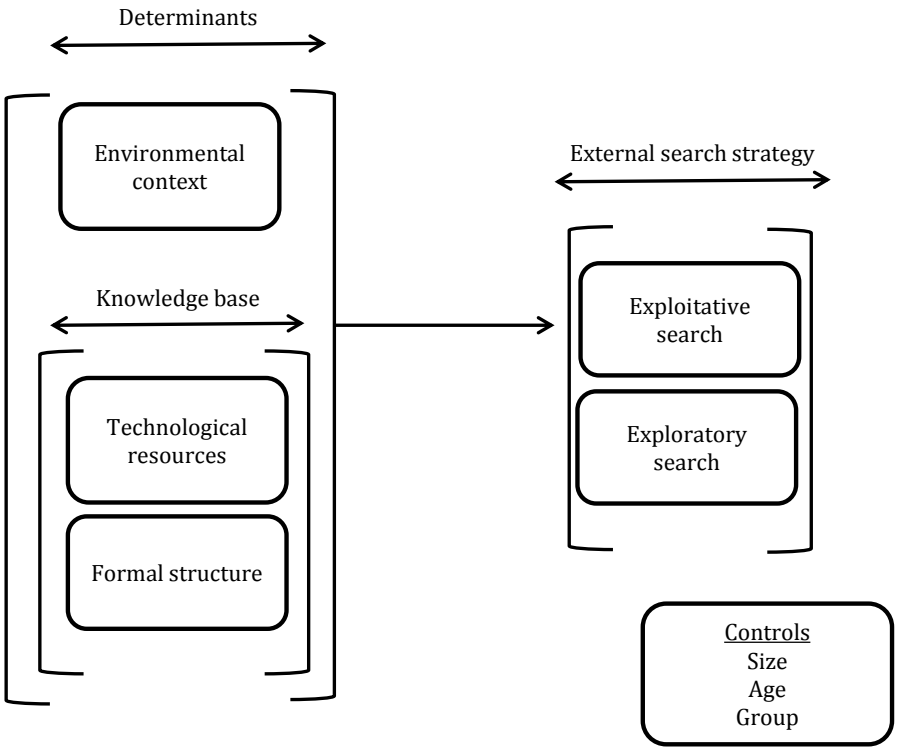
Some scholars consider technological resources as determining the external search strategy (Park et al., 2002; Rothaermel and Deeds, 2004). Of these, Park et al. (2002) hypothesize that resource rich firms, in terms of technological, financial and physical resources, enter alliances of both kinds, that is, exploitative and explorative[3]. However, in their results, only financial resources appear to be significant for exploitative alliances. On the other hand, Rothaermel and Deeds (2004) examine the firm's technological diversity and show that it predicts exploratory alliances.

This is in line with the absorptive capacity hypothesis, which poses that if external knowledge is less applicable to the firm's knowledge base, in-house R&D becomes important for recognizing and assimilating this new knowledge (Cohen and Levinthal, 1990). In the same line, Mangematin and Nesta (1999) show that the higher the firm's R&D[4], the more possibilities of absorbing unrelated knowledge, while the opposite limits such knowledge to a more concrete and applied nature. Vega-Jurado et al. (2008a) show that firm's technological resources[5] exert a positive effect in the acquisition of external scientific knowledge while this relationship does not hold for industrial agents[6] .Along these lines we hypothesize that exploratory search results in a greater focus on R&D to increase absorptive capacity. Greater R&D strength increases the firm's ability to take advantage of external exploratory knowledge. Thus, we hypothesize that:

H5. High technological resources will increase the probability of pursuing an exploratory oriented search strategy.

Thus, organizational structure (formalization of organizational processes and decentralization of decision-making), environmental context (dynamism and competitiveness) and technological resources are presented as determinants of exploratory-exploitative search strategy. Figure 3.2 shows the theoretical framework, which synthesizes the hypotheses.

Figure 3.2 Theoretical framework (I)



Source: Authors' elaboration

3.4.5 Contributions

The hypotheses contribute to current research by extending the work on innovative search and by providing additional insights for absorptive capacity and organizational learning theories. Until the date works on innovative search have focused in industrial conditions and technological resources as determinants of external search strategy but have neglected the role of organizational configurations in this process.

Additionally, studies in organizational learning refer to alternative organizational forms, such as decentralized versus centralized and organic versus mechanistic structures, in the decision to pursue an exploitative or exploratory strategy (Siggelkow and Levinthal, 2003; Csaszar, 2012). However, they focus on the firm's organizational boundaries rather than the mechanisms related to these types of activity in inter-firm relationships (Lavie and Rosenkopf, 2006).

On the other hand, studies in the absorptive capacity tradition analyze the antecedents to external knowledge acquisition especially organizational (Jansen et al., 2005; Vega-Jurado et al., 2008a). However, strategic differences in the external knowledge acquired have not been investigated. We go further by analyzing different search strategies.

3.5 THE ROLE OF FORMAL STRUCTURE AND OTHER FACTORS ON THE EFFECT OF EXTERNAL SEARCH STRATEGY ON FIRM'S INNOVATION PERFORMANCE

3.5.1 State of the art. Moderators on the acquisition of external knowledge and innovation performance

In their seminal article of absorptive capacity Cohen and Levinthal (1990) already talked about the necessity of acquiring and then exploiting external knowledge. In Cohen and Levinthal's (1990) own words: "Absorptive capacity refers not only to the acquisition and assimilation of information by an organization but also to the organization's ability to exploit it. Therefore, an organization's 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). In the same line, Zahra and George (2002) suggested that firms couldn't exploit external knowledge if they had not previously acquired and integrated this knowledge. They labeled efficiency factor, to the ratio between PACAP and RACAP - suggesting that firms vary in their ability to create value from their knowledge base.

In this sense, these studies highlight the belief that acquisition of knowledge does not necessarily imply the capacity for its transformation and exploitation. Thus, while the first section of this chapter dealt with the

acquisition of external knowledge, in terms of Zahra and George (2002) it would be similar to the PACAP dimension of absorptive capacity; in this section of the chapter, we will deal with the exploitation of external knowledge, that is, RACAP.

Theoretical (Baptista and Swan, 1998; Chesbrough, 2003) and empirical research in economic tradition suggests that external knowledge acquisition has a positive effect on the exploitation of external knowledge, or ultimately, firm's innovation performance (Baum et al., 2000a; Rogers et al., 2004; Faems et al., 2005; Lin and Wu, 2010; Zeng et al., 2010). Moreover, most of these studies make use of absorptive capacity theory (Cohen and Levinthal, 1989/1990) to explain the role of firms' internal resources in taking advantage from external knowledge sources. However, among the large number of empirical studies on this topic, the majority examines internal resources through a technological dimension and rather ignores the role of the firm's internal organization in this process.

We argue that technological resources are not enough to explain the process through which external knowledge is eventually exploited and that organizational structure also plays a part and provides a better understanding of the phenomenon. Moreover, we pay attention to the effects on exploratory and exploitative innovations. We address the following question: To what extent does formal structure produce a contingent effect between external knowledge acquisition and innovation results (exploratory and exploitative)?

3.5.2 Comprehending exploratory and exploitative innovations

Multiple typologies of innovation have been proposed and captured in different, sometimes quite elaborate ways. We follow the conceptualization of exploration and exploitation introduced by March (1991), which has been used to capture types of innovative results. In such, we will build on studies that understand exploration and exploitation as

an outcome (Dowell and Swaminathan, 2006; Jansen et al., 2006; Greve, 2007).

Specifically, we follow this definition: Exploitative innovations are principally based on highly related knowledge areas and are directed to satisfying current market demand; exploratory innovation employs more distant knowledge and is aimed at future demand (Benner & Tushman, 2003; Jansen et al., 2006; Greve, 2007).

3.5.3 The role of organizational formal structure in the exploitation of external knowledge

From the absorptive capacity literature we learn that organizational configurations affect not only external knowledge sourcing but also its exploitation. Specifically, formalization can have positive effects on external knowledge exploitation because it imposes clear procedures and eliminates the need for consultation among different subunits (Van Den Bosch et al., 1999; Jansen et al., 2005). To the best of our knowledge, the empirical study of Jansen et al. (2005) is the only one to show that formalization exerts a positive effect on the exploitation of external knowledge. It is argued that codified knowledge is easier to be retrieved in the appropriate time and increases the likelihood that firms' members will identify opportunities for the transformation and exploitation of new external knowledge (Jansen et al., 2005).

In the case of decentralization in decision-making the benefits created by the variety of knowledge generated (Cohen and Levinthal, 1990; Zhang et al., 2007) are not only applied to the absorption of external knowledge but also to its exploitation. Again, few empirical studies have tried to test the effect of delegation of responsibilities on the exploitation of external knowledge. Foss et al. (2010) show that delegation of responsibilities and active participation of employees facilitates the processes that enable the exploitation of external customer's knowledge. In the case of Jansen et al.

(2005) even though they hypothesize a negative relationship in the first place, their results indicate that the empowerment of employees impacts positively the transformation of external knowledge through the initiating of new ideas, insights and opportunities. Nonetheless, their results also show that to eventually exploit this knowledge other systems and structures may be necessary.

In this sense, the scarce evidence coming from the absorptive capacity literature shows that formalization and decentralization are complements (Jansen et al., 2005; Foss et al., 2010). However, drawing on organizational learning theories we argue that introducing into the analysis the differentiation concerning exploratory and exploitative innovation types can add richness to the discussion. As highlighted in other lines of the document, while formalization is more related with exploitative activities decentralization is associated to exploration (Siggelkow and Levithal, 2003; Jansen et al., 2006).

Thus, we argue that the formalization of organizational processes hampers the utilization of knowledge in terms of exploratory innovation by imposing rigid structures and reducing employees' motivation to exploit new and experimental ideas. The narrow space left for deviation from established procedures reduces the possibilities of employees to think and act out of the box.

Decentralization of decision making and the consequential empowerment of employees generally promote greater willingness to assume responsibility, and a higher capacity of creating and exchanging knowledge and skills to solve new problems. Furthermore, empowering employees increases their motivation towards the use and transformation of external knowledge, especially in the case of exploratory innovations. We hypothesize that:

Hypothesis 6: Formalization has a negative moderating effect on the acquisition of external knowledge and exploratory innovation performance.

Hypothesis 7: Decentralization in decision-making exerts a positive moderating effect on acquisition of external knowledge and exploratory innovations.

3.5.4 Other contingent variables

The notion of absorptive capacity has emerged as a conceptual approach to complement studies analyzing external knowledge sourcing and its effect on innovation results. This approach emphasizes the firm's existing knowledge base in the tasks of identifying, assimilating, and exploiting external knowledge. It has been argued that the firm's internal efforts to create new knowledge enhance the firm's innovative performance and also increase the firm's ability to exploit external knowledge sources in the development of new products and processes (Cohen and Levinthal, 1989/1990).

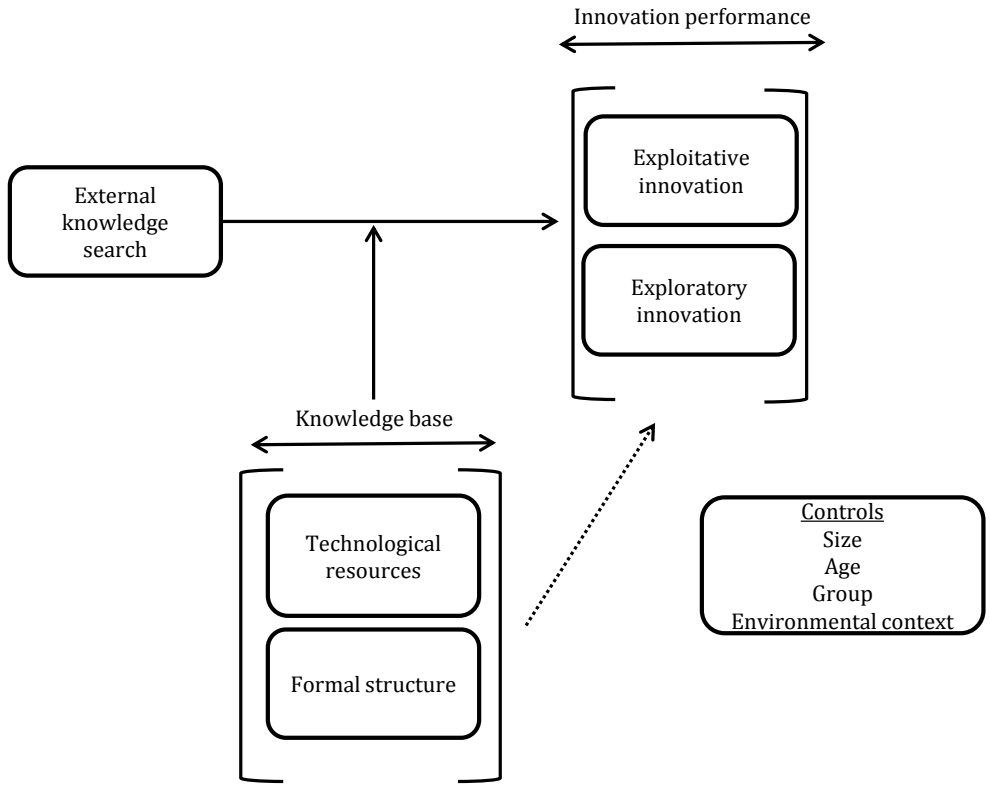
In particular, the argument holds that when outside knowledge is less targeted to the firm's particular needs and concerns, a firm's own R&D becomes more important in permitting not only to recognize the value but also to exploit it (Cohen and Levinthal, 1990). In the same line, Vega-Jurado et al. (2008a) points to a significant effect on the exploitation of scientific knowledge in most of the cases as opposed to industrial knowledge. Schmidt (2010) goes further and argues that only when considering scientific knowledge the increase in R&D intensity leads to positive effects on its exploitation.

From the organizational learning literature we learn that exploratory innovation requires of distant knowledge from that of the firm's knowledge base (Zhou and Li, in press). Moreover, to integrate this knowledge more resources are required. These resources integrate asymmetrical knowledge leading to more novel results. Thus, the enhancement of technological knowledge assists the process of searching in new technological arenas and strengthens the firm's capability to achieve exploratory innovations (Rosenkopf and Nerkar, 2001; Zhou and Wu, 2010). Hence, we hypothesize that:

H8: Technological resources positively moderate the relationship between external knowledge acquisition and firm's exploratory innovation.

Thus, organizational structure (formalization of organizational processes and decentralization of decision-making) and technological resources are presented as moderators of external search and innovation types, that is, exploratory and exploitative innovations. Figure 3.3 shows the theoretical framework, which synthesizes the hypotheses.

Figure 3.3 Theoretical framework (II)



Source: Authors' elaboration

3.5.5 Contributions

The hypotheses contribute to extant research by enriching prior work on the effects of external search on innovation performance. Traditionally, studies anchored in an economic approach focus on technological resources and neglect the role of structure in this relationship (i.e. Cassiman and Veugelers, 2006; Laursen and Salter, 2006). We contribute to this research by integrating into the analysis decentralization and formalization as main dimensions of the firm's formal structure.

Moreover, studies analyzing the antecedents of realized absorptive capacity, that is, the firm's capacity to transform and exploit external knowledge, recognize the role of organizational factors but do not consider the contingent role of exploratory and exploitative innovation outcomes (i.e. Jansen et al., 2005; Vega-Jurado et al., 2008a). In this sense,

we contribute by considering this last point and deriving interesting differences among innovation types.

Lastly, studies in organizational learning literature focus on the effect of structure on exploration and exploitation innovations but still constrain the analyses within organizational boundaries (i.e. Siggelkow and Levinthal, 2003; Csaszar, 2012). We extend this research by considering structure in the context of external knowledge sourcing.

3.6 CONCLUSIONS

Empirical studies considering external knowledge acquisition and internal knowledge generation joint effect on innovation show contradictory findings. This is due to the extreme focus of these studies on internal technological capacities. Despite the theoretical relevance given to organizational factors by absorptive capacity, empirical studies have lagged behind. We argue that the role of organizational structure have been overlooked and should be integrated into the analyses.

For this we deepen into the management literature. This literature focuses on the influence of organizational structure in the leverage of internal knowledge for innovation, and pays little attention to the role of external knowledge in this process (Song et al., 2005). This line of work has evolved in parallel with but with no direct connection to the external knowledge literature (Colombo et al., 2011) which is why, in our view, the relation between organizational structure, innovation and external knowledge processes is still missing.

We intend to bridge across these two bodies of literature in order to disentangle the role played by the firm's formal structure in shaping the sourcing and exploitation of external knowledge. It should improve our understanding of the innovation process through analysis of the

organizational configurations that enable the greatest benefit from external knowledge. Moreover, we add to extant literature by discriminating between exploratory-exploitative search and distinct innovation types.

Chapter 4:
Research methods

4.1 INTRODUCTION

The previous chapter described the theoretical framework and developed the hypotheses of this investigation. This chapter will focus on the research method, first by describing the empirical setting and second by taking a look at the behavior of data. The former informs about the general characteristics of the Spanish ceramic tile industry, specifically ceramic manufacturers, and makes a brief description of the data collection process. The latter describes the central measurements of this research and the descriptive statists. In this sense, some of the basic dimensions of firm's innovative processes, such as the sources of knowledge, the strategies pursued and the nature of the innovation outcome, will be described. Also, the perception of environmental context and the organizational structure will be characterized.

This chapter is organized attending to these criteria. In this way in section 4.2 and section 4.3 we present the research setting and the data collection process. From section 4.4 to 4.6 we describe the measurements and show the descriptive statistics and correlations of the main variables of interest.

We also check for potential bias in our data. Section 4.7 summarizes the main results and concludes.

4.2 THE SPANISH CERAMIC INDUSTRY. TILE PRODUCERS

The empirical study has been developed in the Spanish ceramic tile industry[1]. In the last years the industry has confronted constant pressures from globalization, in particular, due to producers, such as China and Brazil, which base their strategy on costs (Fernández-Mesa, 2012). The industry has faced additional challenges such as, increasing materials and energy prices, firms delocalization and importantly since 2008 the harsh consequences from the economic crisis (Gabaldón-Estevan, 2010). However, despite this environment, Spanish ceramic firms are still highly relevant in the international context: their exports represent between 15% and 18% of international trade (ASCER, 2013).

Table 4.1 shows 2011 data on the sector. For instance, total sales reached 2597 million of euros, of which 73% where destined to foreign markets and the rest to national market. Moreover, Spain is the second producer and exporter European country and the third exporter country worldwide behind Italy and China (IVEX, 2012).

Table 4.2 shows the evolution of production and sales from the year 2007 to 2011. This Table reflects the effects of the economic crisis in the sector. For instance, along this period of time national sales have been continuously decreasing. On the other hand, the figure showing total sales also follows a decreasing tendency until an inflection point in 2011, when total sales start to increase again. Also production, even though showing a decreasing trend between 2007 and 2009, in 2010 starts to increase. The recovery of exports during 2010 and 2011 explains the above figures. For instance, in 2011 exports in the sector represented 1892.1 million of euros,

which is an increment of the 8.3% with respect to 2010. This data corroborates the relevance of ceramic tile sector in the international context.

Table 4.1 2011 Data on the Spanish Ceramic sector

Production
392 million of m2
Second European country and seventh in the world (data from 2010)
Exports
1892 million of € to 182 countries
Second European country and third in the world (data from 2009)
Third industrial sector that adds most comercial surplus to Spain and first in trade coverage
Employment
15500 estimated direct employments
Total sales
2597 estimated millions of €

Source: ASCER, 2013

Table 4.2 Evolution of production and sales from 2007 to 2011*

	2007	2008	2009	2010	2011
Production	584.7	495.2	324.4	366	392
National market sales	1871	1460.3	918	801	705
Exports	2295	2210.9	1673.2	1746.8	1892
Total sales	4166	3671.2	2591.2	2547.8	2597

*Sales in millions of € and production in millions of m2

Source: ASCER, 2013

In Spain the ceramic tile industry is based on firms that are considered to be SMEs as they do not generally exceed an average of 250 workers and they are firms based on family precedence. Moreover, these firms are geographically concentrated in industrial districts. In particular, this tied network of actors is located in the province of Castellón[2], where 81% of the firms in the sector are located and approximately 94% of the Spanish production in the sector takes place (ASCER, 2013).

The distribution of the firms within the sector includes firms operating in the entire productive cycle, that is, from the design of the tile to the firing

and its commercialization. These firms are larger in size, in a range from 40 to 150 employees. Other firms are generally smaller and are specialized in the production of special pieces. These firms are characterized because of their artisanal tile production system (Budí, 2008).

Part of the mineral used by these firms comes from the mines in the district. However, lately as production has being increasing, mineral imports from other countries have acquired importance. Specifically, red clay is found in the district, while white clay has to be imported from outside. If both types of clay have been evaluated as equal in quality terms, white clay aesthetics has been found to be more attractive for the market and practical, because it does not depend on frits to color the ceramic bisque.

A reduced group of firms specialized in the glaze production are also established in the district. These firms are large, around 30 firms have more than 150 employees and the rest even exceed 500 employees. Most of glaze firms belong to multinational corporations, some of them belong to chemistry groups with high world presence, and others, initially emerged from the industrial district but with time acquired a multinational position with plants situated in the main tile producer countries. The glaze is responsible for the final appearance of the product. Thus taking into account the increasing relevance of aesthetics in the market, glazes have become a relevant element in the configuration of firm's competitive advantages.

It is also important to point out the essential role of equipment and machinery suppliers in processes related to production of ceramic tiles. This is reflected in the huge investment in equipment made by tile manufacturers (Flor and Oltra, 2004). This machinery is in great part imported from Italy, although there are some Spanish suppliers specialized in frits and glazed related machinery (Gabaldón-Estevan,

2010). The Italian relevance in this area is clear. For instance, in 2009 the Italian machinery for ceramics was world leader counting with 70% of international exports (Gabaldón-Estevan, 2010). However, it is important to highlight that there is not an absolute dependence of Italian equipment suppliers, because there is a need of adaptation to the final user which makes necessary the collaboration between ceramic firms and machinery suppliers (Budí, 2008).

Finally, the relevant role of auxiliary industry and institutional support reflects the organization of the sector around a district. Specially, universities and research institutes are central players in the district. Specifically the Technological Institute of Ceramics (ITC), which belongs to the Jaume I University, plays a relevant role in the district. The ITC is a Technology Transfer Office (TTO) that, with the University, offers a degree on chemistry engineering specialized in ceramics, which is unique in the world. This guarantees a constant flow of qualified engineers to ceramic firms (Fernández-Mesa, 2012).

Most manufacturing firms in the industrial district innovate through external agents. Specifically, 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, but also producers of frit and glaze framed in the chemistry industry represent a fundamental supplier for ceramic manufacturing firms (Alegre and Chiva, 2008; Villar et al., 2012). Frit and glaze suppliers proportionate firms a substantial amount of R&D, constituting one of the main inputs of technological innovations. Undoubtedly, these firms are the differential element in relation to the final design and quality of ceramic tiles (Budí, 2008). Moreover, the case of frits and glaze suppliers is highly interesting because these firms act as mediators between final producers and science providers, such as universities (Gabaldón-Estevan, 2010).

Districts are characterized by high transfers of inter-organizational information and knowledge (Molina-Morales and Martínez-Fernández, 2008). For this reason manufacturing firms establish more links with external agents. The importance of external knowledge search for innovation in ceramics makes this sector especially appropriate for our analysis. It provides a clear illustration of development, acquisition and exploitation of external knowledge.

Industrial economy literature underlines that innovation across sectors differs in terms of its characteristics, sources, links and the relationships among actors, and the boundaries to the process (Malerba, 2005). For instance, belonging to a specific sector may influence the type of knowledge the firm uses in its innovation processes. In the case of ceramic firms, both scientific and technological knowledge are extremely important for driving technological change (Vega-Jurado et al. 2008b). We understand that equipment suppliers transfer more technological knowledge while, universities, frits suppliers and other R&D providers guarantee the fundamental scientific-based knowledge to the firms in the district.

Overall, the innovation patterns of ceramic firms are generally homogeneous allowing many problems related to economic and technological diversity in inter-sector innovation to be avoided. In this sense, analyzing only ceramic firms can reduce the range of variance that could influence our variables, especially those related to formal organizational structure. Nevertheless we acknowledge that there are some disadvantages to this sampling (i.e. generalization of the results to other contexts is rather problematic), but we believe that studying one specific sector is beneficial for the study of innovation performance (Coombs et al., 1996; Santarelli and Piergiovanni, 1996; Alegre and Chiva, 2008; Fernández-Mesa et al., 2012).

4.3 THE COLLECTION OF DATA

Secondary sources of information such as the Technological Innovation Survey (PITEC) or the Survey of Business Strategies (SBS) have favored the realization of abundant studies concerning external knowledge sourcing and innovation performance. However, due to our interest in deepening into the firm's organizational structure, we decided to elaborate and launch our own survey in which we introduced concrete questions about organizational design.

Thus, our data was collected through a survey administered in 2011 to ceramic manufacturers[3]. The questionnaire was addressed to heads of R&D departments; where this function did not exist, we asked another manager, such as the technical director, to complete it. The questionnaire was pretested to ensure that the questions were clear. We also recruited trained interviewers to conduct onsite interviews in order to generate valid information and high-quality data (See Annex V and VI where the full questionnaire is attached).

We estimated the population by considering the manufacturing firms' belonging to the business association, ASCER, which includes as its members the firms developing the final product and some of the smaller firms producing special pieces[4]. The members belonging to this association represent nearly the whole population. Indeed, the firms that are not associated, mostly artisanal and of reduced size, represent less than 3% of the production and exports of the sector. In 2011 this raises up to 132 firms, which constitutes our target population (See Annex I for firm contacts). Our sample included 105 manufacturing firms, that is 99 final producers and 6 specialized firms; hence the response rate was of 80%.

4.4 MEASUREMENTS

Table 4.3 summarizes the theoretical constructs, the description and scales of the measurements and the literature source of the main variables of interest for this investigation. In the elaboration of the survey design we took into consideration measurements already validated in the literature. Also, it is important to take into consideration that we use measures based on managerial perceptions. For instance, Park et al. (2002) point to the appropriateness of managers' perceptions of the firm's decision to enter an alliance because they have been shown to be more powerful predictors than objective measures. In the following lines we detail the construction of the measurements.

4.4.1 External knowledge sourcing

The conceptualization of external knowledge sourcing differs within the literature. As explained in Chapter 2, there is a stream in the literature that discriminates between the mechanisms used to acquire external knowledge (cooperating, licensing, contracting R&D…), and another stream that focuses on the nature of the partner or knowledge provider involved in the process (suppliers, clients, competitors, universities…). Studies in this area usually employ general questions to extract information on the existence of a relationship with external agents or the involvement of the firm in particular mechanisms, as indicators of external knowledge sourcing activity.

In this study we use the mechanisms for acquiring external knowledge (OECD-Eurostat, 2005)[5]. Specifically we consider whether the firm uses external R&D, acquisition of machinery and equipment, acquisition of hardware and software, acquisition of additional external knowledge, training or consulting. The Cronbach's alpha (α) is 0.85 indicating that the items forming this index are reliable.

Following Laursen and Salter (2006) we are interested in the breadth of external knowledge sourcing and consider the number of mechanisms used by firms to acquire knowledge from external sources. Thus, we created a construct integrating the questions related to the sum of the different mechanisms used. The final variable was calculated by grouping the value of external sourcing into: 0 if the firm used no mechanism, 1 if the firm used 1-3 mechanisms and 2 if the firm used 3-6 mechanisms. This is an ordinal scale of the breadth of the firm's external knowledge sourcing activities.

4.4.2 Formal organizational structure

The capacity to acquire and exploit external knowledge cannot be considered only through the technological dimension. In this sense, the particular characteristics of the firm's formal structure are determinant to external knowledge acquisition and exploitation. Formalization and delegation of decision-making are central to the definition of organizational structure (Jansen et al., 2006). Thus, a measure of these two features should allow us to characterize the firm's organizational structure. Following the description of formalization and decentralization in Jansen et al. (2005/2006) we included in the survey two questions related to these practices. For the case of formalization, respondents were asked whether the firm's norms and established procedures were systematically followed by the organization. This question was designed to capture to what extend rules and procedures occupied a central place in the organization. For the case of decentralization, we asked whether working teams had autonomy for decision-making in order to capture the extent to which employees are encouraged to use initiative. In both cases, the responses were scored on a Likert scale from 1 (totally disagree) to 4 (totally agree).

4.4.3 Technological resources

Traditionally, technological activities are measured as share of R&D expenditure in total turnover (Laursen and Salter, 2006; Schmidt, 2010). However, we use percentage of employees dedicated to internal R&D to proxy for the firm's internal technological activities (Keupp and Gassmann, 2009). This measure was chosen because the percentage of employees is a more stable indicator than total R&D expenditure over sales, which can show wide variations. For instance, a firm could decide to make a one-off purchase of expensive equipment, or might have higher sales fluctuations in a specific year for a variety of reasons. Another reason for choosing this measure is that employees (i.e. human capital) are more strongly related to tacit knowledge and experience (Muscio, 2007).

4.4.4 Environmental context

Environmental context has been characterized in multiple ways in the literature (Park et al., 2002; Dias and Magriço, 2012). Two main dimensions have been described as dynamism and competitiveness (Sidhu et al., 2004; Jansen et al., 2006; Sidhu et al., 2007).

As mentioned before, environmental competitiveness can be defined as the extent to which environmental contexts are characterized by intense competition (Matusik and Hill, 1998). In line with this definition we construct a variable with three items, that is, strong competition in our market; firm has strong competitors; price competition is a characteristic of the market (Jansen et al., 2006; Van Wijk et al., 2012). The variable was calculated as the mean (α= 0.76) on a 1 to 4 scale (1 totally disagree to 4 totally agree).

Table 4.3 Theoretical constructs, description and scale of measurements and literature source

Theoretical dimension	Description	Scale of measurement	Literature source
External knowledge sourcing	Number of mechanisms used to acquire knowledge: (i) external R&D (ii) acquisition of machinery and equipment (iii) acquisition of hardware and software (iv) acquisition of additional external knowledge (v) training (vi) consulting	0: the firm used no mechanism 1: the firm used 1-3 mechanisms 3: the firm used 3-6 mechanisms	OECD-Eurostat, 2005 Laursen and Salter, 2006
Formal organization structure			Jansen et al., 2005
Formalization	The firm's norms and established procedures were systematically followed by the organization	1: totally disagree 2: disagree 3: agree 4: totally agree	Jansen et al., 2006
Decentralization	Working teams had autonomy for decision-making	1: totally disagree 2: disagree 3: agree 4: totally agree	
Technological resources	Employees dedicated to internal R&D	Percentage	Keupp and Gassmann, 2009
Environmental context			Jansen et al., 2006
Environmental competitiveness	(i) strong competition in our market (ii) firm has strong competitors (iii) price competition is a characteristic of the market	1: totally disagree 2: disagree 3: agree 4: totally agree	Van Wijk et al., 2012

Source: Authors' elaboration

Table 4.3 (continued)

Theoretical dimension	Description	Scale of measurement	Literature source
Environmental dynamism	(i) frequent changes to the market	1: totally disagree	
	(ii) frequent demand for new products and services	2: disagree	
	(iii) frequent changes to demand for goods and services	3: agree	
	(iv) frequent changes to the technology	4: totally agree	
External strategy search	Partnering with suppliers, clients, competitors, institutes,	1: the firm engages in neither exploitation nor exploration	Laursen and Salter, 2006
	consultants, laboratories, private and public R&D	alliances	March, 1991
	universities, and technology centers, is motivated by:	2: exploitation orientation	Gupta et al., 2006
	(i) access to complementary resources allowing	3: equal pursuit of both searches	Lavie and Rosenkopf, 2006
	improvements to the firm's main business lines	4: exploration orientation	
	(ii) cost reductions		
	(i) access to complementary resources facilitating the exploration of new technological areas		
	(ii) access to networks beyond the business sector		
Innovation performance	Degree of intensity of the following results:		OECD/Eurostat, 2005
Exploitation	(i) quality improvement to a good or service	1: low intensity	Jansen et al., 2006
	(ii) reduction in costs of production	2: medium intensity	
	(iii) improved production capacity	3: high intensity	
	(iv) greater user satisfaction		
Exploration	(i) degree in which the firm has identified new markets	1: low intensity	
	(ii) degree in which the firm has accessed new markets	2: medium intensity	
	(iii) exploration of new technological areas	3: high intensity	

Source: Authors' elaboration

On the other hand, dynamism was defined as "the rate of change and the degree of unpredictability of environmental change" (Dess and Beard, 1984). To capture the concept of dynamism we consider two dimensions, they are, market and technology (Jansen et al., 2006). Thus, this variable is composed of four items: frequent changes to the market; frequent demand for new products and services; frequent changes to demand for goods and services; frequent changes to the technology (Jansen et al., 2006). The variable was calculated as the mean (α= 0.68) on a 1 to 4 scale (1 totally disagree to 4 totally agree).

4.4.5 External knowledge search strategies

Multiple measures can be applied to characterize external search. Patents provide information on technological trajectories and are an available and informative source of data (Petruzzelli et al., 2012). However, patent data do not account for firm-specific variations in the propensity to patent (Faems et al., 2005). Information gathered through questionnaires overcomes some of these limitations and many studies of external search use this method (Laursen and Salter, 2006; Paananen, 2009). In ceramics tile sector, patents are not extensively used to protect innovation (Fernández-Mesa et al., 2012), so we rely on the responses to our questionnaire.

We follow the approach in Laursen and Salter (2006) which focuses on search channels, such as suppliers and other external agents that firms use in their search for knowledge and innovation. Laursen and Salter capture the breath of the firm's external knowledge search by accounting for all the external sources used. We also distinguish between exploration and exploitation. Recalling the theoretical definition: "exploitative external search involves the use of new knowledge that is in the neighborhood of firm's prior knowledge base" while "exploratory external search implies

the pursuit of knowledge that differs from that of the firm's knowledge stock" (Katila and Ahuja, 2002; Gupta et al., 2006)

This variable was constructed as follows. First, we asked firms whether partnering with particular external agents, that is, suppliers, clients, competitors, consultants, laboratories, private and public R&D institutes, universities, and technology centers, was motivated by exploration or exploitation objectives. Exploration is understood as access to complementary resources facilitating the exploration of new technological areas and access to networks beyond the business sector. Exploitation is defined as access to complementary resources allowing improvements to the firm's main business lines and cost reductions (March, 1991; Gupta et al., 2006).

Second, we added up the numbers of exploration alliances with each of the seven agents. This resulted in a variable ranging from 0 to 7 representing exploration breadth. We followed the same procedure for exploitation, creating a second variable ranging from 0 to 7 representing exploitation breadth. We assume that the wider the scope (higher the number) of exploration the higher is the firm's involvement in exploratory activities and vice versa (Laursen and Salter, 2006).

Third, we computed a ratio between exploration and exploitation to provide a unique variable in the range 0 to 7. This operationalization reflects the continuous nature of exploration and exploitation, where lower values indicate a tendency for exploitation and high values reflect the firm's exploratory orientation (Lavie and Rosenkopf, 2006; Su and McNamara, 2012). Lastly, for analytical reasons, we grouped the values: 0 means that the firm engages in neither exploitation nor exploration (category 1) alliances, values greater than 0 and under 1 indicate an exploitation orientation (category 2); values equating 1reflect an equal

pursuit of both types of search (category 3); and values above 1 refer to an exploration orientation (category 4).

4.4.6 Exploratory and exploitative innovation performance

Innovation performance has been explained in the literature by using multiple indicators. Output-based indicators have included indicators such as patents, the identification of innovations in technical and specialized journals, share of firms total sales deriving from innovative products etc. (Flor and Oltra, 2004)[6]. Specially patents have been used frequently; however we understand that: One, given firm-specific variations in the propensity to patent and the very real possibility that patents are inputs in the product development process and not an output, equating the amount of patent activity with innovation performance can be questioned (Faems et al., 2005). Two, it is noteworthy that patents are not used as an innovation protection system in the ceramic tile industry (Alegre-Vidal et al., 2004; Fernández-Mesa et al., 2012). Indeed, the study of Flor and Oltra (2004) shows that methods based on primary information are more suitable for identifying the group of firms producing innovative processes in the ceramic tile industry.

For these reasons, in this investigation we will use questionnaire data. Specifically, innovation performance is measured by an indicator based on the effects derived from firm innovation (OECD/Eurostat, 2005). This measure has been validated in the literature and provides valuable information about the innovative activity of firms (Alegre and Chiva, 2008). Moreover, in line with the hypotheses formulated, we understand that innovation can be understood as exploratory and exploitative. Recalling the theoretical definition: "exploitative innovations are based on highly related knowledge areas and is directed to satisfy current market demand" while "exploratory innovations employ more distant knowledge

and is aimed at satisfying current demand" (Benner and Tushman, 2003, Jansen et al., 2006; Greve et al., 2007).

Studying a single industry makes exploration and exploitation an appropriate distinction to capture the multiple features of innovation outcomes. To construct these variables we used the responses to the question about the degree of intensity of several innovation results taking place in the firm on a scale of 1 (low intensity) to 3 (high intensity). This indicator is based on the Oslo Manual (OECD-Eurostat, 2005). Following the classification proposed by Jansen et al. (2006) we grouped these results into exploration and exploitation. Hence the effects of exploratory innovations are measured along three dimensions: (i) degree in which the firm has identified new markets; (ii) degree in which the firm has accessed new markets; and (iii) exploration of new technological areas. On the other hand, the effect of exploitative innovations was measured along the dimensions of: (i) quality improvement to a good or service; (ii) reduction in costs of production; (iii) improved production capacity; and (iv) greater user satisfaction. The Cronbach's alpha (α) for both constructs is 0.74 indicating that the items in the index are reliable. Based on these results we created two constructs by calculating the mean of the corresponding items.

4.4.7 Control variables

The research model includes several controls for possible confounding effects. The Schumpeterian hypothesis argues that large firms have an innovation advantage over smaller firms in terms of output, because firm size affects the endowment of important inputs to the innovation process, and the achievement of economies of scale in R&D, the ability to spread risks over a portfolio of projects and access to a larger pool of financial resources (Veugelers, 1997). Thus, small firms cannot risk "betting on the wrong horse", but large firms can afford to run multiple projects which

increases their chances of effective exploitation of external knowledge (Schmidt, 2010). In the analysis we control for the effect of firm size by including the natural logarithm of the total number of employees.

Previous studies show that the age of the firm affects innovation. On the one hand, older firms have more experience than newer firms, which may be positive for external knowledge search and innovation (Sorensen and Stuart, 2000). One the other hand, there can be negative effects of older age. As firms mature they have a higher possibility of becoming more dependent on routines, becoming inflexible and rigid, which deters organization openness and its effect on innovation (Hannan and Freeman, 1984). Thus, we control for number of years since the firm's foundation.

The final control is an indicator for belonging to a group. Firms that are part of a group may show different behavior in relation to innovation results. They may have more opportunities to access additional resources that can be used to achieve innovation (Gooding and Wagner, 1985; Vega Jurado et al., 2009). In order to measure the dependency of the firm on a group we use a dummy variable that takes the value 1 if the firm interacts with the same group of enterprises and 0 otherwise. This goes beyond traditional measures that provide information only about membership or not of a group; our measure indicates interaction between the firm and the group indicating access to and exploitation of resources.

4.5 DESCRIPTIVE STATISTICS

The data analysis starts with the use of descriptive statistics. These statistics makes data more intelligible and are appropriate to describe sector practices (Flynn et al., 1990). Table 4.4 presents the means, standard deviations and the range of the data distribution for the number of observations available.

Table 4.4 Descriptive statistics

	Observations	Mean	Std. Dev.	Minimum	Maximum
External knowledge sourcing	105	1.65	0.64	0	2
Technological resources	102	4.71	7.28	0	60
Decentralization of decision-making	104	2.72	0.89	1	4
Formalization of organizational processes	104	3.17	0.7	1	4
Competitiveness	105	3.53	0.47	2.34	4
Dynamism	105	3.19	0.45	1.75	4
Size	105	4.31	0.87	1.61	6.62
Age	105	27.5	13.96	6	62
Group	105	0.37	0.48	0	1
External search strategy	105	1.39	1.34	0	3
Exploitative innovation	102	2.04	0.53	1	3
Exploratory innovation	105	2.09	0.58	1	3

Source: Authors' elaboration

The figures in relation to acquisition of external knowledge show high values reflecting that the majority of firms have acquired external knowledge. This result confirms the increasing relevance of external knowledge. In the specific context of the ceramic tile sector, the acquisition of knowledge is a generalized strategy. An analysis of the variables distribution show that 8.6% of the firms do not adopt any external search mechanism, 19% of firms pursue between 1 and 3 search mechanisms and 73.3% use 3 to 6 different mechanisms. The behavior of this variable reflects that the majority of firms acquire knowledge through multiple activities ranging from the acquisition of R&D to the contracting of consulting services (See Table 4.5 for more detail).

In the case of firms' technological activities, the percentage of employees dedicated to R&D activities rises to 4.71%. Compared to the proportion for the whole of the Spanish manufacturing industry, which is 2.98% (INE, 2010), the ceramic producers dedicate on average almost 50% more employees to activities related to the generation of scientific and

technological resources. For a detailed distribution of the variable see Table 4.6.

Table 4.5 Number of firms using different innovation activities involving the acquisition of external knowledge

	Frequency	Percentage
External R&D	81	77.1
Acquisition of machinery and equipment	81	77.1
Acquisition of hardware and software	81	77.1
Acquisition of additional external knowledge	71	67.6
Training	87	82.9
Consulting	80	76.2
Total	105	100

Source: Authors' elaboration

Table 4.6 Distribution of R&D employees

	Frequency	Percentage
0	23	22.5
1	1	1
2	19	18.6
3	12	11.8
4	8	7.8
5	17	16.7
6	4	3.9
7	1	1
8	5	4.9
9	1	1
10	5	4.9
12	1	1
15	1	1
18	1	1
20	1	1
33	1	1
60	1	1
Total	102	100

Source: Authors' elaboration

Firms in the sample score high in relation to the presence of both characteristics outlined as relevant for the definition of organizational structure. In the case of decentralization of decision-making, ceramic firms

score on average 2.72 out of a scale of 4 indicating that in general terms firms agree in a moderate level on the fact that employees have autonomy for decision-making. In the case of formalization of organizational processes firm's score on average 3.17 out of 4 reflecting that in general terms firms highly agree that their norms and procedures are systematically followed by the organization. Table 4.7 and 4.8 shows the frequencies of these two variables.

Table 4.7 Distribution of decentralization of decision-making

	Frequency	Percentage
1	7	6.7
2	38	36.5
3	36	34.6
4	23	22.1
Total	104	100

Source: Authors' elaboration

Table 4.8 Distribution of formalization of organizational processes

	Frequency	Percentage
1	3	2.9
2	9	8.7
3	59	56.7
4	33	31.7
Total	104	100

Source: Authors' elaboration

In relation to the manager's perceptions towards the environment, the descriptive statistics show that managers on average value competitiveness to be very high (the variable rises up to an average of 3.53 out of 4). In the case of perceptions towards dynamic environments, managers also perceive environments to be highly dynamic but not as much as in the case of competitiveness dimension (on average firms score

3.19 out of 4). Table 4.9 and 4.10 show the frequencies of these two variables.

Table 4.9 Distribution of environmental competitiveness

	Frequency	Percentage
2.33	2	1.9
2.67	5	4.8
3.00	21	20.0
3.33	20	19.0
3.67	14	13.3.
4.00	43	41.0
Total	105	100.0

Source: Authors' elaboration

Table 4.10 Distribution of environmental dynamism

	Frequency	Percentage
1.75	2	1.9
2.25	4	3.8
2.50	2	1.9
2.75	18	17.1
3.00	13	12.4
3.25	30	28.6
3.50	17	16.2
3.75	16	15.2
4.00	3	2.9
Total	105	100,0

Source: Authors' elaboration

The four last variables, that is, exploitative external search, exploratory external search, exploitative innovation and exploratory innovation are fundamental for our analysis because in the future analysis will be the dependent variables (See chapter 5).

Table 4.11 shows the number of firms partnering with each external agent for exploration, for exploitation, or both. The table shows that in general suppliers and clients, that is, industry agents, are chosen for exploitative reasons and consultants, universities, public research bodies and technology centers, that is, scientific and technological sources, are chosen in order to explore new technological areas. This supports studies that use scientific sources to proxy for explorative search and industry sources to proxy for exploitative search (Faems et al., 2005; Gilsing and Nooteboom, 2006). Moreover, as described in the measurement section, external knowledge search strategy was constructed attending to the number of times the firm partnerships for exploration, exploitation reasons or both. Table 4.12 shows the final distribution of this variable.

In the case of exploitative and exploratory innovations, the frequencies in Tables 4.13 and 4.14 show that firms are pretty well distributed in an inverted U shape, that is, most of the firms are situated at an intermediate level. In other words, most of the firms explore and exploit at a medium intensity.

Lastly it is important to point out that the bivariate correlations between the variables presented are not high (See Table 4.15). These low correlations inform us that multicollinearity is probably not a problem in our data. However, this issue will be treated later in Chapter 5.

Table 4.11 Number of firms partnering with external agents for exploratory, exploitative reasons or both*

External agents	No partnering involved	Exploitation	Exploration	Exploration and exploitation	Other reasons**
Suppliers	21	23	18	20	23
Clients	50	19	11	6	19
Competitors	86	8	6	2	3
Consultants, laboratories or R&D private institutes	42	8	35	12	8
Universities	50	7	28	13	7
Public research bodies	59	7	24	8	7
Technology centres	67	3	24	8	3

*Number of observations: 105

This includes the following reasons: access to new markets, gain of credibility within markets and other unidentified reasons.

Source: Authors' elaboration

Table 4.12 Distribution of external search strategy

Category	Frequency	Percentage
1 (values=0)	23	21.9
2 (values [0,1])	21	20
3 (values=1)	17	16.2
4 (values>1)	44	41.9
Total	105	100

Source: Authors' elaboration

Table 4.13 Distribution of exploitation innovation

	Frequency	Percentage
1.00	8	7.8
1.25	4	3.9
1,5	12	11.8
1.75	13	12.7
2.00	15	14.7
2.25	18	17.6
2.50	19	18.6
2.75	9	8.8
3.00	4	3.9
Total	102	100.0

Source: Authors' elaboration

Table 4.14 Distribution of exploratory innovation

	Frequency	Percentage
1.00	11	10.5
1.33	6	5.7
1.67	12	11.4
2.00	29	27.6
2.33	23	21,4
2.67	11	10.5
3.00	13	12.4
Total	105	100.0

Source: Authors' elaboration

4.6 COMMON METHOD AND NON-RESPONSE BIAS

In studies were data is self-reported and comes from the same questionnaire common method variance can bias estimates. To analyze the extent of common method bias we used Harman's one-factor test (Podsakoff and Organ, 1986; Fey and Birkinshaw, 2005). Table 4.16 shows that there are four factors with an eigenvalue greater than one accounting for 62.04% of the total variance. Moreover, the results demonstrate that the first factor aggregates 30.01% of the variance. The existence of several differentiated factors and the reduced variance related to the first factor

suggests that the estimations are not biased by common method variance (Fey and Birkinshaw, 2005). We also took into consideration the possibility of non-response bias. However a response rate of 80% already indicates low levels of non-response bias (Alegre and Chiva, 2008).

Table 4.15 Spearman correlation coefficients

	1	2	3	4	5	6	7	8	9
1. Acquisition of external knowledge	1								
2. Technological resources	0.36**	1							
3. Decentralization of decision-making	0.26**	0.16	1						
4. Formalization of organizational processes	0.09	0.09	0.04	1					
5. Competitiveness	0.07	0.03	-0.03	0.02	1				
6. Dynamism	0.16*	0.10	0.18*	0.06	-0.14	1			
7. Size	0.48**	0.25**	0.37**	-0.02	0.21**	0.32**	1		
8. Age	0.16	0.09	0.15	0.14	0.05	0.08	0.31**	1	
9. Group	0.21**	0.20**	0.09	0.05	-0.05	0.11	0.28**	0.15	1

*p<0.10 **p<.05
Source: Authors' elaboration

Table 4.16 Testing for common method bias. Principal components factor analysis*

Component	Total	% of variance	% cumulative variance
1	3.30	30.01	30.01
2	1.27	11.59	41.60
3	1.18	10.71	52.30
4	1.07	9.73	62.03
5	0.86	7.81	69.85
6	0.81	7.39	77.24
7	0.74	6.75	83.99
8	0.72	6.55	90.54
9	0.48	4.34	94.89
10	0.34	3.09	97.98
11	0.22	2.02	100

*Initial Eigenvalues
Source: Authors' elaboration

4.7 CONCLUSIONS

In this chapter we presented the empirical setting of the investigation. Specifically, we detailed the most relevant characteristics of ceramic tile manufacturers. That is, the presence of significant innovation and its high dependence on external sources of knowledge. Specially, we detailed how equipment plus frit and enamel suppliers are central agents in the transfer of knowledge to manufacturers. Moreover, we described the data collection process and the measurements to be used later in the empirical analyses. In this sense, we detailed the construction of relevant variables as external knowledge sourcing, formal organizational structure, technological resources, environmental context, external search strategies and exploratory and exploitative innovation performance. We also performed descriptive statistics to understand the behavior of these variables. Of particular interest is the distribution of external search strategy and innovation; explanatory variables in the next chapter. External search strategy follows a continuous distribution reflecting the degree of exploitative- exploratory search. On the contrary, two separate variables are built for exploitative and exploratory innovation, which follow a normal distribution. We also checked for possible multicollinearity in our data, which could create a bias in the interpretation of econometric results but this was not a problem. Common method bias and non-response bias were also not relevant problems in this investigation.

Chapter 5:

Empirical analyses on the determinants and effects of external knowledge search

5.1 INTRODUCTION

In this chapter we will test the hypotheses formulated in chapter 3. On the one hand, we will test the effect of formal organizational structure, environmental context and, technological on external search strategy. On the other hand, we will estimate the moderating role of technological resources and formal structure on external knowledge sourcing and innovation performance, considering innovation as exploratory and exploitative.

Section 5.2 will focus on the formal structure influencing external knowledge search strategies and section 5.3 will analyze the moderating effect of formal structure on external knowledge sourcing and exploratory-exploitative innovations. In these two sections we will describe the econometric models to be used in responding to our two main research questions, the estimation method and the statistical analyses. Section 5.4 summarizes the main results in relation to both research questions.

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5.2 EMPIRICAL STUDY ON THE DETERMINANTS OF EXTERNAL KNOWLEDGE SEARCH STRATEGY

5.2.1 Econometric specification

In order to respond to the first question of our investigation, that is, the determinants of external knowledge search strategy, we will take into consideration variables making reference to the firm's environmental context, dynamism (Dyn) and competitiveness (Com), and to the internal firm's dimensions, that is, technological resources (TR), decentralization of decision-making (Dec) and formalization of organizational processes (For), plus the variables related to size, age and group. These variables will explain external knowledge search strategy (EKSS), which will represent our dependent variable. Figure 5.1 shows the econometric specification.

Figure 5.1 Econometric specification. Determinants of external knowledge search strategy

$$EKSS_i^d = \beta_0 + \beta_1 Dyn_i + \beta_2 Com_i + \beta_3 TR_i + \beta_4 Dec_i + \beta_5 For_i + \beta_6 Size_i + \beta_7 Age_i + \beta_8 Group_i + \varepsilon_i^d$$

Source: Authors' elaboration

Taking into consideration the variables exposed above, in this specific analysis the initial sample of 105 firms was reduced to 101 firms due to the fact that some of the cases in these variables were missing.

5.2.2 Estimation method

Our dependent variable takes mutually exclusive and unordered values, thus the multinomial logit distribution is most appropriate to investigate our hypotheses. In addition to the low collinearity found between the

variables in Chapter 4, we calculated variance inflation factors and the maximum value was 1.56, which is below the rule-of-thumb of 10 (Neter et al., 1996). These indicators show that there are no multicollinearity problems (See Annex IV).

Moreover, this distribution assumes the independence of irrelevant alternatives (IIA) is satisfied (Hausman and McFadden, 1984). This means that adding or deleting outcome categories has no effect on the odds of the remaining outcomes. To ensure IIA we compare the multinomial logit and probit models. Both models produce similar estimates and goodness of fit measures (For complete analyses of the IIA assumption see Annex II).

5.2.3 Results

Tables 5.1 and 5.2 present the multinomial logit regressions. Table 5.1 shows the results calculated with category 1 as the reference category, that is, the probability of not pursuing external search; Table 5.2 takes category 2 as the reference that is the probability of pursuing exploitative search. The former indicates the extent to which the independent variables matters for external search; the latter reflects the extent to which the variables predict more or less exploratory search compared to exploitative search. Annex III, shows the marginal effects derived from estimation of the multinomial logit in Tables 5.1 and 5.2. These are calculated holding all other variables at their means (Long, 1997). The results for each variable of interest are detailed below.

In line with our central thesis the results show that structure matters for external knowledge search and the strategy pursued. Although formalization is not significant (which rejects hypothesis 1), decentralization has a positive and significant impact on exploratory oriented search, taking both categories as the reference. According to the theory, structures characterized by decentralized processes explain external knowledge sourcing (see Table 5.1). More importantly, our results

also show that decentralization is a determinant of an exploratory rather than an exploitative strategy (see Table 5.2). Marginal effects corroborate these results, showing a change from negative to positive values as the search becomes less exploitative and more exploratory (see Annex III). In the specific case of category 4 the results for marginal effects show that a unit increase in decentralization increases the predicted probability of exploration by 23%. This supports hypothesis 2.

A dynamic environment results in negative and significant coefficients for exploitative and balanced searches compared to no external search, suggesting a higher probability of internal search (see Table 5.1). Moreover, a dynamic environment seems not to determine the type of external search strategy pursued (See Table 5.2). This is corroborated by the results for marginal effects (see Annex III), and rejects hypothesis 3.

A competitive environment results in negative and significant coefficients of exploratory search, when considering both categories as the reference. In line with the theory, competition has negative effects for exploratory search compared to the probability of no external search (see Table 5.1). In relation to the results for the probability of pursuing an exploratory strategy rather than an exploitative strategy we find a negative coefficient (see Table 5.2). This indicates that in highly competitive environments exploratory search is less likely. Marginal effects (see Annex III) corroborate these results and indicate that as competition increases the probability of pursuing a more exploratory search strategy decreases by 39% compared to a more exploitative search strategy. These results support hypothesis 4.

Technological resources have an impact on the search for external knowledge, which is in line with the literature on the role of R&D for accessing external knowledge (see Table 5.1). Specifically, results show positive and significant coefficients of exploitation search. In the case of

R&D role in the choice between an exploratory or exploitative strategy results are not significant (see Table 5.2). However, results tend to indicate that R&D explains exploitative searches rather than exploratory oriented ones. Thus, hypothesis 5 is not accepted.

In relation to the control variables the results show the following. The firm's size is positively associated with the probability of accessing external knowledge. This result is in line with predictions suggesting that large firms count with more resources and thus, greater chances to access external sources of knowledge. Firm's age also tends to be associated to greater external search because of added benefits in terms of experience. Lastly, belonging to a group also tends to be positive for external knowledge sourcing. In this sense, these firms have more opportunities to access additional resources.

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Table 5.1 Multinomial logit regression, explaining the use of external knowledge sources in detriment of internal sources of knowledge

Variable	Category of reference(1)		Category(2)		Category(3)		Category(4)	
	Estimate	p-value	Estimate	p-value	Estimate	p-value	Estimate	p-value
Formalization of organizational processes	-	-	0.468	0.525	1.240	0.115	-0.259	0.718
Decentralization of decision making	-	-	0.299	0.577	0.854	0.128	1.308***	0.009
Dynamic environment	-	-	-1.733*	0.073	-2.153**	0.039	-1.135	0.239
Competitive environment	-	-	-0.328	0.742	-0.517	0.610	-1.919**	0.039
Technological resources	-	-	0.152**	0.037	0.110	0.118	0.092	0.228
Size	-	-	2.687***	0.001	1.542**	0.050	2.780***	0.000
Group	-	-	-0.449	0.717	1.627	0.123	1.115	0.279
Age	-	-	0.048	0.173	0.061*	0.093	0.056	0.105
Intercept	-	-	-7.930	0.156	-6.007	0.311	-4.546	0.389

*p<0,10 **p<0,05 ***p<0,01

N=101

Log-likelihood: -90.353071

$\chi 2$:0.0000

Pseudo R^2: 0.3107

Source: Authors' elaboration

Table 5.2 Multinomial logit regression, explaining the use of more balanced and exploratory strategies vs. exploitative

Variable	Category (1)		Category of reference (2)		Category (3)		Category(4)	
	Estimate	p-value	Estimate	p-value	Estimate	p-value	Estimate	p-value
Formalization of organizational processes	-0.468	0.525	-	-	0.772	0.250	-0.727	0.192
Decentralization of decision making	-0.299	0.577	-	-	0.556	0.285	1.009**	0.020
Dynamic environment	1.733*	0.073	-	-	-0.419	0.604	0.599	0.383
Competitive environment	0.328	0.742	-	-	-0.188	0.842	-1.591**	0.047
Technological resources	-0.152**	0.037	-	-	-0.042	0.415	-0.061	0.126
Size	-2.687***	0.001	-	-	-1.145**	0.058	0.093	0.858
Group	0.449	0.717	-	-	2.076**	0.053	1.565	0.102
Age	-0.048	0.173	-	-	0.013	0.626	0.008	0.729
Intercept	7.930	0.156	-	-	1.923	0.695	3.384	0.393

*p<0,10 **p<0,05 ***p<0,01

N=101

Log-likelihood: -90.353071

$\chi 2$:0.0000

Pseudo R^2: 0.3107

Source: Authors' elaboration

Table 5.3 Summary of hypotheses and results on the determinants of external search strategy

Hypothesis: Probability of pursuing an exploratory oriented external search strategy	Results
H1 Formalization of organizational processes exerts a negative effect	✗
H2 Decentralization of decision-making exerts a positive effect	✓
H3 Environmental dynamism exerts a positive effect	✗
H4 Environmental competitiveness exerts a negative effect	✓
H5 Technological resources exerts a positive effect	✗

Source: Authors' elaboration

5.3 EMPIRICAL STUDY ON THE EFFECTS OF EXTERNAL KNOWLEDGE ON INNOVATION PERFORMANCE: THE MODERATING ROLE OF ORGANIZATIONAL STRUCTURE

5.3.1 Econometric model

In order to respond to the second question of our investigation, that is, the influence of organizational structure in the effect of external knowledge on innovation, we propose two econometric models to test the hypotheses developed. The first analyzes the external and internal antecedents to firms' innovation performance. In particular, it allows us to analyze the extent in which external knowledge sourcing and internal characteristics, both technological resources and formal structure, exert an influence on innovation results. The model includes the explanatory variables: acquisition of external knowledge (AEK), technological resources (TR), decentralization of decision-making (Dec) and formalization of organizational processes (For), plus the variables related to size, age and group. Figure 5.2 shows the econometric model for the antecedents to innovation performance.

Figure 5.2 Econometric model. Antecedents of innovation performance (main effects)

$$INNOV_i^d = \beta_0 + \beta_1 AEK_i + \beta_2 TR_i + \beta_3 Dec_i + \beta_4 For_i + \beta_5 Size_i + \beta_6 Age_i + \beta_7 Group_i + \varepsilon_i^d$$

where i=1,…,N (number of observations) and d = Exploration, exploitation

Source: Authors' elaboration

In relation to the main objectives of this study we explore the role of internal characteristics as moderators in the process of acquisition and exploitation of external knowledge. Moderators are introduced in regressions when they are aimed to addressing "when" or "for whom" a variable most strongly predicts or causes an outcome variable. In other

words, a moderator is a variable that alters the direction or strength of the relation between a predictor and an outcome. The identification of important moderators reflects unexpectedly weak or inconsistent relations between predictors and outcome across studies. Plus, interaction effects are at the heart of theory in social sciences (Frazier et al., 2004)[1]

In line with previous studies we introduce as a moderator variable, technological resources (Miotti and Sachwald, 2003; Cassiman and Veugelers, 2006). Moreover, in line with our main objective and to enrich the literature, we include formal structure. The second model, in addition to the variables considered in the first model, includes the interactive terms calculated as the product from multiplying "AEK" by each type of internal characteristic, that is, both technological resources (TR) and formal structure (Dec and For). Figure 5.3 shows the econometric model for the antecedents of innovation performance.

Figure 5.3 Econometric specification. Antecedents of innovation performance (interaction effects)

$$INNOV_i^d = \beta_0 + \beta_1 AEK_i + \beta_2 TR_i + \beta_3 Dec_i + \beta_4 For_i + \beta_5 AEK_i * TR_i + \beta_6 AEK_i * Dec_i + \beta_7 AEK_i * For_i + \beta_8 Size_i + \beta_9 Age_i + \beta_{10} Group_i + \varepsilon_i^d$$

where i=1,…,N (number of observations) and d *= Exploration, exploitation*

Source: Authors' elaboration

Our analysis considers the effects of innovation on the basis of the typology exploration and exploitation. We run model 1 (Figure 5.2) and model 2 (Figure 5.3) for each of these dimensions. In total we apply four equations, two for each type of innovation results.

It is important to point out that from an initial sample of 105 firms the final sample used in this analysis is of 98 firms. This reduction is due because of the elimination of cases with missing data.

5.3.2 Estimation method

The dependent variables figuring in the econometric models follow a normal distribution. Thus, the hypotheses are tested using standard ordinary least squares (OLS) regression techniques. In addition to the low collinearity found between the variables in Chapter 4, we calculated variance inflation factors and the maximum value was 1.95, which is below the rule-of-thumb of 10 (Neter et al., 1996). These indicators suggest that there are no multicollinearity problems (See Annex IV).

5.3.3 Results

Table 5.4 present the results of the regressions for the effects of innovation, taking account of the categories of exploitation and exploration. The first two models in the table present the main effects and the controls for our explanatory variables; the last two models are concerned with the interaction effects. Interaction effects were created by multiplying together the main variables and standardizing them to reduce potential multicollinearity problems.

Overall, our models present high R2 values, indicating that an important part of the variance is explained. Model 1 explains 42% of the variance, and this increases by 8% when the interactions terms are included (Model 3). Model 2 explains 40% of the variance and this increase to 5% when the moderator effects are considered (Model 4). The results show that the changes in R2 are highly significant indicating that it is appropriate to introduce moderator effects in our model.

The results related to the main effects (Model 1 and Model 2) reveal that acquisition of external knowledge has a strong influence on both exploratory and exploitative innovation outputs. As intuitively argued in the analysis of descriptive statistics (Chapter 4), this result is in line with much of the innovation literature, which underscore the importance of external knowledge sourcing for innovation (Chesbrough, 2003; Cassiman

and Veugelers, 2006). In the particular case of exploratory innovations, the acquisition of external knowledge and also certain internal characteristics, such as R&D and decentralization in decision-making are significant. This confirms that exploratory innovations are more dependent on internal R&D and decentralization of decision-making. This is in line with Jansen et al.'s (2006) study, which shows that centralization in decision-making is detrimental to exploratory innovation. Moreover, size shows a significant effect reflecting that bigger firms, because of their greater access to additional resources, are at an advantage when pursuing innovation.

We analyzed the moderating effects in order to answer our research questions. As traditional studies on external knowledge sourcing underline, our study shows that technological resources are important moderators of acquisition of knowledge and innovation. In this sense, we can confirm that the development of in-house R&D activities facilitates learning from external sources and its ultimate conversion into innovation outputs. This study also confirms that formal structure makes a difference in this process and is line with our general claim regarding the necessity to incorporate these factors into knowledge sourcing analyses. In the case of decentralization of decision-making the relationships are not significant, so we can draw no clear conclusions from these results. In the case of formalization our results are in line with our hypothesis on the negative effect on the exploitation of external knowledge in terms of exploratory innovation results.

Table 5.4 Ordinary least squares regression results: predictors of innovation performance

	Main effects				Interaction effects			
	Exploitative Innovation		Exploratory innovation		Exploitative Innovation		Exploratory innovation	
	Model 1		Model 2		Model 3		Model 4	
	b	t	b	t	b	t	b	t
Constant	0.90***	3.53	1.15***	4.09	0.81***	3.27	1.11***	3.95
Acquisition of external knowledge	0.27***	2.95	0.23***	2.44	0.33***	3.11	0.29***	2.67
Technological resources	0.04	0.52	0.17**	2	0.24***	2.5	0.29***	3.08
Decentralization	0.07	0.75	0.22***	2.5	0.08	0.97	0.21***	2.4
Formalization	-0.06	-0.76	-0.05	-0.63	-0.13*	-1.67	-0.1	-1.19
Size	0.41***	4.02	0.34***	3.28	0.44***	4.44	0.34***	3.36
Age	0.04	0.5	-0.01	-0.13	0.06	0.68	0	-0.03
Group	0.05	0.54	-0.03	-0.27	0.03	0.36	-0.05	-0.58
Acquisition of external knowledge x Technological resources					0.34***	3.31	0.20***	1.92
Acquisition of external knowledge x Decentralization					0	0.03	0.07	0.71
Acquisition of external knowledge x Formalization					-0.13	-1.59	-0.17***	-1.92
R^2	0.42		0.4		0.5		0.45	
Change in R^2	0.42		0.4		0.08		0.05	
F for change in R^2	9.42***		8.85***		4.55***		2.61**	
F for model	9.42***		8.85***		8.73***		7.30***	
Number of observations	98		101		98		101	

*p<0,10 **p<0,05 ***p<0,01

Source: Authors' elaboration

Table 5.5 Summary of hypotheses and results on the effects of external knowledge on exploitative innovation

Hypothesis: Moderating effects	Results
H6 Formalization of organizational processes exerts a negative effect	✗
H7 Decentralization of decision-making exerts a positive effect	✗
H8 Technological resources exerts a positive effect	✓

Source: Authors' elaboration

Table 5.6 Summary of hypotheses and results on the effects of external knowledge on exploratory innovation

Hypothesis: Moderating effects	Results
H6 Formalization of organizational processes exerts a negative effect	✓
H7 Decentralization of decision-making exerts a positive effect	✗
H8 Technological resources exerts a positive effect	✓

Source: Authors' elaboration

5.4 CONCLUSIONS

5.4.1 Conclusions on the determinants of external knowledge search strategy

Our results show that decentralized structures are a major determinant of an exploratory strategy. High levels of employee autonomy enable the search for distant and unfamiliar knowledge and encourage experimentation with new alternatives. However, there is no evidence that structures characterized by high formalization drive an exploitative search strategy. We hypothesized that implementing specific procedures would facilitate the search for knowledge within related domains. However, our results show that this is not the case and that the proximity of such knowledge to the firm's current expertise does not need an established process for its acquisition.

In addition to formal structures for shaping firm strategy, our results show the influence of the environment. In particular, we find that strong market competition has a negative influence on exploratory oriented search in favor of exploitation. These results confirm our hypothesis of competitive environments promoting the introduction of lower costs and a strategy oriented to improving on existent expertise. Contrary to our expectations, a dynamic environment does not explain the external search strategy or external knowledge acquisition. There is some empirical evidence suggesting that increased uncertainty increases the contingencies faced by the firm and enhances the possibility of internal search (Noordewier et al., 1990).

In line with the absorptive capacity literature we hypothesized that R&D would become more necessary with the distance of external knowledge from the firm's existing knowledge base, in order to enable its recognition and assimilation. However, our results suggest that even though R&D is a

predictor of knowledge acquisition, the search is more exploitaive in nature.These results suggest that an analysis in depth of this variable should be undertaken. R&D is a too broad measure; it includes different activities, culture, management and other features (Barge-Gil and López, 2011). Thus, probably knowing the orientation of R&D would help us to explain better this relationship.

5.4.2 Conclusions on the effects of external knowledge on innovation performance: the moderating effect of organizational structure

In this section we show that the acquisition of knowledge beyond organizational boundaries is fundamental for achieving innovation. In this sense, our results confirm the acquisition of external knowledge contributes not only to the refinement and extension of existing competences and technologies but also to experimentation with new alternatives (March, 1991).

However, our results reveal that this relationship is not direct: Organizational structure, which involves the alignment of distinct organizational knowledge components, is fundamental to the process. Our results show that types of formal structure exert different effects in the final exploitation of external knowledge. In particular, formalization clearly is a strongly significant and negative factor in this relationship.

In the case of formalization results show a negative effect on the exploitation of external knowledge. Formalization creates rigid inflexible structures, which are a barrier to the integration of knowledge and ultimately hinder the transformation of external knowledge into innovations results. The imposition of formalized procedures can also affect employee motivation by reducing their autonomy. This contrasts with studies that find formalization and greater codification favors exploitation of external knowledge through the provision of clear rules and certainty in decision-making (Jansen et al., 2005). Our study suggests

that greater formalization impedes the flow of information within the organization and has a detrimental effect on the eventual exploitation of external knowledge.

In particular, our results show that formalization is a barrier to the utilization of external knowledge for exploratory innovation. Exploratory innovation is usually associated with disruptive results based on knowledge unrelated to the firm's knowledge base. To achieve this, some scholars defend flexible organizational structures (Jansen et al., 2006). Our results show that in the case of external knowledge integration the need for flexibility in the organizational structure is a necessary condition. In this sense, the negative moderating effect of formalization on acquisition of knowledge and innovation is even more relevant in the case of exploratory innovation. The fact that such innovation builds on distant and novel knowledge implies the need for greater creativity, which is less likely within rigid structures.

The present study confirms the findings in the literature on the role played by firm's technological resources for innovation. Investment in R&D contributes to accumulation in the firm's knowledge stock, which is one of the principal sources of new product discovery (Afuah, 2002). Our results show that when considering the joint effects of external knowledge acquisition and internal knowledge generation, technological activities are even more important. This result is in line with Cohen and Levinthal's (1990) conceptualization of the two faces of R&D. In this perspective, R&D is considered not only to generate innovation but also to enhance the firm's ability to identify, assimilate and exploit knowledge from the environment, that is, to increase the firm's 'learning' or 'absorptive' capacity. In this sense, the role of R&D as a facilitator of the learning processes involved in external knowledge sourcing appears central to the generation of innovation. This finding chimes with empirical studies on

internal R&D as a fundamental factor in the processes involved in the exploitation of external knowledge sources.

Also, our results show that while R&D has a direct effect only on exploratory innovation, they show that it has an important moderating effect on both exploitative and exploratory innovation. Studies in the literature acknowledge that the accumulation of technological knowledge allows firms to experiment beyond current technological knowledge boundaries and therefore increase the firm's ability to produce exploratory innovation (Rosenkopf and Nerkar, 2001; Zhou and Wu, 2010), and this is endorsed by our results. Some studies claim a complementary effect between R&D activities and external knowledge sourcing (Miotti and Sachwald, 2003; Cassiman and Veugelers, 2006). Our study also confirms the existence of a synergic effect and that this applies to both dimensions of innovation.

Chapter 6:

General conclusions

6.1 GENERAL CONCLUSIONS

Answering the first research question, this PhD set out to investigate the mechanisms driving exploitative and exploratory external search. The extant literature has investigated environmental features and firm characteristics such as technological resources, as the determinants of search strategies. However, this study aimed to advance our understanding by analyzing the role of formal structure, conceptualized in terms of formalization of organizational processes and decentralization of decision-making. Our results emphasize that the mechanisms underlying exploration and exploitation are intrinsically different and emerge under distinct organizational routines and capabilities.

In particular, the results show that a decentralized organizational structure plays a role in shaping the firm's external search strategy. In particular, a decentralized structure encourages the use of an exploratory search strategy to the detriment of exploitative search. Thus, structures facilitating employee's autonomy are highly beneficial for empowering and encouraging open behaviours. In particular, it benefits the search for distant and unrelated knowledge from their own knowledge and thus,

orientates the firm towards an exploratory search strategy. In the case of formalization results were not significant, thus we cannot confirm the fact that procedures facilitates nor impedes the acquisition of external knowledge. In general, results on formal structure minimize the importance of formalization in external knowledge sourcing, and enhance the relevance of decentralization.

Results also show that R&D affects external knowledge search, which chimes with previous studies informing about the role of R&D as a determinant of external search. Furthermore, results exhibit a higher probability associated to the pursuit of exploitative external oriented searches. Surprisingly, not R&D but concretely, decentralized structures are the facilitators of exploratory searches. These results emphasize the relevance of decentralization and also incentivices further research to develop more analysis in order to determine the real effect on the different activities involving R&D and external knowledge search.

Organizational behavior is driven not only by firm characteristics but also by external factors originated in the environment. We find that competition inhibits exploratory search. It is important to recall that, on average, the perception of managers towards competition was relatively high. In this sense, these results suggest that this type of perception highly inhibits the search for new and exploratory knowledge. On the other hand, even though dynamic environment perceptions were also quite common among firm's managers, no effect is confirmed on external search propensity. Even more, results suggest that dynamic environments could be explaining a more internal oriented search. In this sense, we could argue that as environments become more unpredictable, contingencies faced by firms increase, enhancing internal oriented searches.

On the other hand, this PhD responds to the second research question by analyzing the role of moderators in the process involving knowledge

acquisition and its ultimate conversion into exploitative and exploratory innovations. Previous work explaining firm success in exploiting external knowledge focus on technological resources as relevant moderators. Our results show that not only is R&D important, but the firm's formal structure also matters.

Specifically, results show positive or negative effects, depending on the type of structure analyzed. In this sense, formalization tends to have a detrimental effect in the transformation of external knowledge into innovation outputs. Specifically, results indicate that the effect is highly detrimental in the case of exploratory innovations. Moreover, descriptive statistics show that ceramic firms present high degrees of formalization, that is, rules and procedures are systematically followed in the organization. Thus, this result demonstrates to be highly relevant for this type of firms. It shows that formalization, which is a common practice in most ceramic firms, is preventing exploratory innovations and damaging the firm's capacity for adaptation to environmental changes. On the other hand, in the case of decentralization results are non-significant. We cannot confirm a negative effect, such as decentralization slowing down the transformation and exploitation of external knowledge, or a positive effect, as hypothesized. Thus, we are unable to reach clear conclusions on this last point.

Latly, results also show that technological resources moderate the relationship between external knowledge and innovation. In particular, the effect is positive for both types of innovation, that is, exploratory and exploitative. This result is in line with studies showing a complementary effect between external knowledge sourcing and internal technological capacities in terms of innovation performance. In this sense, R&D facilitates the integration of external knowledge and its final exploitation.

The study of the determinants and effects of external knowledge search proportionates a complete picture of the input and output of external knowledge processes. Specifically, in the case of structure, results show that formalization is an aspect to take into consideration when analyzing the exploitation of external knowledge. More importantly, when considering exploratory innovations. Decentralization, on the other hand, exerts an effect in the search for exploratory knowledge. These results extol the benefits of decentralization, especially in the phase where firms search for exploratory knowledge and more need of creating diversity within the firm's knowledge base is needed. Results also highlight the disadvantages associated to formalization. Formalization because of its proclivity to create rigid structures is highly detrimental in the case of exploiting external knowledge, especially in terms of exploratory innovations.

On top of these particular findings, the thesis has major implications for theoretical research into the determinants and effects of external knowledge search. Most of this stream of the literature has treated the firm's organizational dimension as fixed across firms. Thus, the general objective of this thesis was to integrate the organizational dimension in the analysis of external knowledge sourcing processes and the role of strategy and innovation types. On the one hand, results contribute to the literature on innovative search by extolling the organizational dimension in configuring the firm's external search strategy. On the other hand, this study shows that firm's organizational structure is a relevant determinant in the utilization of external knowledge in terms of different kinds of innovation.

However, indirectly this thesis also adds insights to the absorptive capacity literature. Studies on absorptive capacity theory highlight organizational factors as determinant of external knowledge sourcing and exploitation but ignore their impact on individual strategies. By

introducing the distinction between exploration and exploitation we contribute to this literature. Furthermore, our results add to the organizational learning literature by extending our knowledge of exploration and exploitation and inter-firm relationships.

Summing up, this thesis achieves that multiple strands of the literature talk to each other, possibiliting gains in terms of providing richer insights to the research questions formulated. Following Shafique (2012) we belive that multidisciplinarity is needed for "tapping the full potential of research".

On a practical level, this work has some implications for managers. The successful implementation of external knowledge search is challenging corporate decision making in organizations. This study shows managers that the design of the organizational structure makes a difference on the technological strategy pursued, and eventually can have a relevant effect on the exploitation of external knowledge in terms of innovation results. Innovation policy-makers should also be aware of the results. Recent public schemes incentivizing external agents and firms partnering may have discouraging negative results when the firms do not possess the appropriate resources and structure in order to leverage and utilize the external knowledge acquired. Therefore, the firm's characteristics, especially their organizational structure, should also be considered in the frame of these policies.

6.2 LIMITATIONS AND FURTHER RESEARCH

This thesis has some important limitations. First, this study is conducted on a single industry, which reduces the generalization of results to other settings. In the future a multi-sector analysis would allow generalizing results. Also, larger data set would also result in some non-significant relationships becoming significant. Second, the use of self-reported data

can also be considered as a limitation. It would be very interesting to collect additional objective data for measuring the dependent variables and thus, avoid biases and add robustness to our results. Third, this study uses cross-sectional data leading to possible causality problems. Further research using longitudinal data could reduce these problems. Moreover, pursuing qualitative research, such as semi-structured and personal interviews, could also provide insights to this investigation by providing a deeper understanding of the object of study.

Also, future research could focus on additional dimensions of external knowledge sourcing, such as the depth dimensions of external search (Laursen and Salter, 2006; Chiang and Hung, 2010; Sofka and Grimpe, 2010). Also, the inclusion of other organizational attributes such as shared responsibility or commitment could provide this study with additional insights (Song et al., 2006; Thongpapanl et al., 2012). Moreover, the recent discussion on new organizational forms could be an interesting avenue for future research. All in all, this would enrich debate on the role of organizational dimension in the analysis of the determinants and effects of external search.

ENDNOTES

CHAPTER 2

1.Technological knowledge is defined as two dimensional: basic scientific knowledge and applied and experimental development, design and prototype work (Howells et al., 2003; Barge-Gil and López, 2011)

2.Lane and Lubatkin (1998) employ the terms 'teacher firm' and 'student firm', being the former the firm that provides knowledge and the latter the firm that receives the knowledge.

3. Governance modes influence the ease of knowledge exchange and other factors such as, the firms control and ownership of outcomes (division of profits, IP…) (Howells et al., 2003)

4.External knowledge sourcing based on market procurement also includes other forms such as mergers and acquisitions, technologies embodied in equipment etc. (Pisano and Teece, 1989; Howells et al., 2003)

5. In Howells et al. (2003) words: "Many companies are still reluctant to outsource critical technologies to outside suppliers however there are increasingly contemplating to subcontract more routine, low value added research and technical activities"

6. Several classifications have been elaborated according to the type of external sources that the firms' access in their search for innovative ideas. For instance, a very general taxonomy is one that includes horizontal and vertical sources. The first group is composed by competitors and research centers, while the second group considers the upstream and downstream

agents belonging to the value chain, such as clients and suppliers. Another taxonomy widely utilized is the one offered by the Oslo's Manual (OCDE/Eurostat, 2005), which differentiates between commercial sources, sources that depend on the public sector and sources of general information. This classification does not only represent the active knowledge sources, but also passive sources of knowledge.

7.Other recent studies have attempted a reconceptualization of the definition such as Zahra and George (2002) or Durisin and Todorova (2007), which further characterize absorptive capacity as a bundle of four and five capabilities respectively.

8. Zahra and George (2002) and Durisin and Todorova (2007) also highlight the importance of organizational capabilities in building absorptive capacity but strictly basing their arguments on theoretical grounds.

9.In words of Van den Bosch et al. (1999): "organization forms are the bones, however, combinative capabilities, provide the necessary flesh and blood" (p. 557). In other words, organizational form acts as a "type of infrastructure", while combinative capabilities "integrate" the "mosaic of individual capabilities" enabling the process of absorption of external knowledge (p.554). Organizational forms are conceptualized in the well-known traditional forms; however combinative capabilities (Kogut and Zander, 1992) are conceptualized into three groups: "Coordination capabilities" enhance knowledge exchange though relations between members of a group across disciplinary (horizontal) and hierarchical (vertical) boundaries avoiding self-contained units. These mechanisms underscore the relations between members of a group and may be explicitly designed or emerge from a process of interaction (Van den Bosch et al., 1999; Jansen et al., 2005). "Systems capabilities" describe the

degree to which behaviors are programmed in advance of their execution and provide a memory for handling routine situations. "Socialization capabilities" specify broad, tacitly understood rules for appropriate action under unspecified contingencies. These capabilities provide common codes of communication and dominant values (Van den Bosch et al., 1999; Jansen et al., 2005).

10.In order to reach to this argumentation the authors follow the following reasoning: the degree of knowledge assimilation depends on three dimensions: scope, flexibility and efficiency. They assume that both the scope and flexibility of knowledge absorption have a positive influence on the level of absorptive capacity, while efficiency has a negative impact. For example, systems capabilities exert a high effect on efficiency and low effect on scope and flexibility, thus, the effect of these capabilities on absorptive capacity will be low.

11. They additionally analyse the effects of absorptive capacity and organizational factors in the context of turbulent knowledge environments.

12."Cross functional interfaces" involve the relationships between corporate and divisional R&D labs or, more generally, the relationships among the formal innovating unit (the R&D lab) and other functional areas, such as design, manufacturing, and marketing functions (Cohen and Levinthal, 1990; Jansen et al., 2005). "Job rotation" originated as a Japanese practice and implies lateral transfer of employees between jobs or functional areas creating diverse knowledge structures (Van den Bosch et al., 1999; Jansen et al., 2005). "Participation in decision-making" indicates the extent to which subordinates are empowered to take part in higher-level decision-making processes (Damanpour, 1991). "Routinization" captures the firms' development of tasks that require

relatively little attention and ensures that inputs are transformed into outputs. "Formalization" is the degree to which procedures, rules, instructions and communications are codified or written down (Khandwalla, 1977). "Connectedness" reflects the structural aspect of social relations or density of linkages. In a similar vein as the rest of combinative capabilities, connectedness facilitates knowledge exchange; though the knowledge sharing occurs through informal channels (Zahra and George, 2002; Jansen et al., 2005) "Socialization tactics" reflects the cognitive aspect or shared social experiences of social relations. Socialization tactics leads to a common understanding about beliefs, values and needs among individuals within an organization. Socialization tactics include making newcomers understand the organizations specific language facilitating the comprehension of background knowledge and communication with others (Jansen et al., 2005).

13.Inspired in the theoretical framework by Zahra and George (2002) where they conceptualize absorptive capacity as a dynamic capability which integrates two main dimensions: Potential absorptive capacity (PACAP), which integrates the capacity of acquiring and assimilating external knowledge, and realized absorptive capacity (RACAP), which integrates the capacity of transforming and exploiting external knowledge.

14. We will describe the specific effects in the next chapter.

15. Scientific absorptive capacity (PACAP and RACAP) refers to the firm's ability to absorb technological knowledge from universities, technology institutes, and public and private research centers; and industrial absorptive capacity (PACAP and RACAP) is the ability to assimilate and exploit knowledge from actors in the industrial chain.

16. We will describe the specific effects in the next chapter.

17.This is surprising, as one would expect the exploitation of inter-industry knowledge to also be influenced by collaboration among departments. The authors argue that the exploitation of inter-industry knowledge for innovations might require less collaboration because a large amount of that knowledge is embodied in products from suppliers and each employee can take the knowledge needed for his or her innovation activities directly from the product.

18. The authors add some elements to Van den Bosch et al. (1999) study, such as the effect of network position in shaping absorptive capacity and the analysis of strategic innovation as a relevant output.

CHAPTER 3

1. There is high confusion in the literature between the terminology of exploration and exploitation and radical and incremental innovations (Li et al., 2008). However, in this thesis we follow He and Wong (2004) approach and use scales of exploration and exploitation because we are making reference to a firm and its existing capabilities, resources, and processes, and not to a competitor or to the industry level. In this sense, an exploration activity to one firm might be an exploitation activity to another, or vice versa.

2. Dias and Madriço (2012) theoretically analyzes environmental uncertainty by integrating market, technology, and competition dimensions into one construct and its effect on inter-firm alliance strategies. However, in their empirical tests they do not differentiate between exploration and exploitation.

3. Technological resources were measured in terms of scope, understanding that the more technologies a firm has the more diverse its

technological resources are and more opportunities for alliances due to their broad exposure to technological changes.

4. Generally by R&D, scholars mean R&D expenditure (i.e. R&D intensity). However, Mangematin and Nesta (1999) refer also to individual's skills and measure it as variables such as the employees' level of education and the share of scientists and engineers in total employee.

5. Vega-Jurado et al. (2008a) understands technological resources as "R&D intensity, the existence of an R&D department and the education level of the workforce".

6. Vega-Jurado et al. (2008a) argue that as the firms' knowledge base becomes more similar to that of universities and research institutes, the better are the conditions to learn from each other.

CHAPTER 4

1. The ceramic industrial process revolves around the production of tiles (floor and pavement tiles and tiling). Ceramic tiles are used as an intermediate product by construction firms and as a consumer good in the restoration of residential accommodation (Flor and Oltra, 2004).

2. 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.

3. The questionnaire was developed in coordination with the following institutions: Universitat Jaume I, AERT –Grup de Reçerca, INGENIO (CSIC-UPV), Universitat Politècnica de València, Ministerio de Ciencia e Innovación.

4. We focused our analysis on a homogeneous set of firms, that is the final producers of tiles (firms belonging to ASCER). However, in addition to these firms, the questionnaire was also sent to the members of ANFECC (National Spanish Association of Ceramic Frits, Glazes and Ceramic Pigments) and to the members of ASEBEC (Spanish Association of machinery manufacturers for the ceramic tile industry). ANFECC has 26 members in 2012, and represented nearly all the firms of fits, glazes and pigments of the sector. ASEBEC had 36 members in 2012 and also represented nearly the total population. The final sample was of 26 and 36 firms respectively.

5. We use mechanisms instead of agents because of data availability. The question on agents (Part B, question B.1), asks about the existence of a relationship between the firm and the external agent. However, this question is too broad and could be referring to other activities that are not innovation based. Moreover, the additional question in the questionnaire about mechanisms (Part B, question B.2) is associated to the distinct agents and complicates the measurement of external knowledge sourcing.

6. We use output indicators in detriment of indicators based on the inputs of the innovation process, such as R&D expenditure or the existence of formalized R&D activity, which have traditionally been used to address firms' technological innovation.

CHAPTER 5

1.The choice of moderating effects in detriment of mediating effects depends on the theory being tested**.**

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Annex I. Target population.

Company contacts

Manufacturing firm	Phone Number	E-mail Address
ADEX, S.L.	(+34) 96 1321214	info@adexspain.com
ADOBE CERAMICAS, S.L.	(+34) 964 342 061	info@adobeceramicas.es
ALAPLANA-REAL CERAMICA	(+34) 964 590 201	alaplana@alaplana.es
ALBAGRES	(+34) 964 367 410	albagres@albagres.es
ALCALAGRES, S.A.	(+34) 91 8865920	general@alcalagres.com
ALCALATEN, S.A.	(+34) 964 360 744	ceramicas@alcalaten.com
ALFA CERAMICA Y PORCELANICO, S.A.	(+34) 964 670 542	alfa@alfaceramica.com
ALTTOGLASS, S.A.	(+34) 964 577 878	alttoglass@alttoglass.com
AMIZALSA	(+34) 964 386 350	info@amizalsa.es
APAVISA PORCELANICO	(+34) 964 701 120	info@apavisa.com
ARANDA S.L.	(+34) 964 360 084	ventas@arandaalcorense.es
ARCIBLANSA	(+34) 964 386 373	info@arciblansa.com
ATOMCER, S.A.	(+34) 964 363 080	
ATOMIX, S.A.	(+34) 964 601 652	
ATOMIZADORA, S.A.	(+34) 964 603 111	empresa@atomizadora.com
AZTECA	(+34) 964 367 500	comercial@azteca.es
AZULEJERA ALCORENSE	(+34) 964 505 225	azulejera@alcorense.com
AZULEJOS ALCOR	(+34) 964 367 575	alcor@azulejosalcor.com
AZULEJOS EL MIJARES, S.L.	(+34) 964 776 575	mijares@azulejosmijares.com
AZULEJOS MALLOL, S.A.	(+34) 964 360 115	mallol@azulejosmallol.com
AZULEV, S.A.	(+34) 964 776 565	azulev@azulev.es
AZULIBER	(+34) 964 367 400	azuliber@azuliber.com
AZULINDUS & MARTI, S.A.	(+34) 964 600 250	azulindus@azulindusymarti.com
AZULMAT, S.L.	(+34) 964 360 501	azulmat@azulmat.es
BALDOCER, S.A.	(+34) 902 459 000	baldocer@baldocer.com
BALLESTER PORCAR, S.L.	(+34) 964 626 333	info@ballesport.com
BRANCÓS Ceramics	(+34) 972 641 000	info@brancos.com
CE.VI.CA., S.L.	(+34) 964 244 178	cevica@cevica.es
CERACASA, S.A.	(+34) 964 361 611	ceracasa@ceracasa.com
CERAMICA CAS, S.L.	(+34) 964 601 114	ventas@casceramica.com
CERAMICA DA VINCI, S.L.	(+34) 964 360 505	ceramicadavinci@ceramicadavinci.com
CERAMICA DECORATIVA, S.A.	(+34) 96 2850366	info@decorativa.es
CERAMICA ELIAS, S.A.	(+34) 93 7710157	comercial@ceramicaelias.com
CERAMICA ESTILKER, S.L.	(+34) 964 601 463	estilker@ceramicaestilker.com
CERAMICA LATINA, S.L.	(+34) 964 381 696	ceramicalatina@ceramicalatina.com
CERAMICA MAYOR, S.A.	(+34) 96 5881175	mayor@ceramicamayor.com
CERAMICA RIBESALBES, S.A.	(+34) 964 603 252	comercial@ceramicaribesalbes.com

Source: ASCER, 2011

Manufacturing firm	Phone Number	E-mail Address
CERAMICALCORA, S.A.	(+34) 964 367 373	comercial@ceramicalcora.com
CERAMICAS APARICI, S.A.	(+34) 964 701 010	ceramicas@aparici.com
CERAMICAS AZAHAR, INCEAZAHAR	(+34) 964 701 020	ceramicas-azahar@incea.com
CERAMICAS CALAF, S.A.	(+34) 93 8698250	info@ceramicascalaf.com
CERAMICAS MIMAS, S.L.	(+34) 964 783 500	mimas@ceramicasmimas.com
CERAMICAS MYR, S.L.	(+34) 964 360 167	general@ceramicasmyr.com
CERAMICAS VILAR ALBARO, S.L.	(+34) 964 361 825	comercial@salcamar.com
CERANOSA	(+34) 964 360 211	ceranosa@ceranosa.com
CERLAT, S.A.	(+34) 964 776 570	cerlat@cerlat.com
CERPA, S.L.	(+34) 964 601 651	administracion@cerpa.com
COLORKER	(+34) 964 361 616	colorker@colorker.com
CRISTACER	(+34) 964 602 852	cristal@cristalceramicas.com
DECOCER, S.A.	(+34) 964 626 272	comercial@decocer.com
DELTAKER, S.A.	(+34) 964 776 240	deltaker@deltaker.com
DUAL GRES, S.A.	(+34) 964 771 166	general@dualgres.com
EL BARCO, S.L.	(+34) 964 600 147	elbarco@elbarco.com
EL MOLINO	(+34) 964 776 020	elmolino@elmolino.es
ELIRA, DESIGN & CERAMICS	(+34) 964 328 384	comercial@tresestilos.com
EN&CEL	(+34) 964 367 320	ceramica@bestile.es
EQUIPE CERAMICAS, S.L.	(+34) 964 381 930	comercial@equipeceramicas.com
ESKEMA CERAMICAS	(+34) 964 776 622	ceramicas@ceraworldceramicas.com
ESTUDIO CERAMICO	(+34) 964 328 187	comercial_dep@estudioceramico.es
EUROARCE	(+34) 976 232 069	euroarce@samca.com
EUROATOMIZADO, S.A.	(+34) 964 776 610	euroatomizado@euroatomizado.com
EXAGRES, S.A.	(+34) 964 623 250	exagres@exagres.es
FABRESA	(+34) 964 380 011	info@fabresa.com
FANAL CERAMICAS, S.A.	(+34) 964 771 177	fanal@fanal.com
GAROGRES, S.A.	(+34) 964 701 056	ventas@garogres.com; export@garogres.com
GAYAFORES	(+34) 964 626 262	info@gayafores.es
GLASS CERAMICA S.L.	(+34) 964 38 19 00	glassceramica@glassceramica.es
GRES CATALAN	(+34) 93 8699800	grescatalan@grescatalan.com
GRES DE ARAGON	(+34) 978 830 511	gresaragon@gresaragon.com
GRES DE BREDA	(+34) 93 7412970	info@gresdebreda.com
GRES FORT, S.A.	(+34) 964 530 240	gresfort@gresfort.com
GRES LUNA, S.A.	(+34) 964 367 600	gresluna@gresluna.es
GRESAN	(+34) 964 626 398	exportacion@gresan.com
GRES-CID	(+34) 964 381 155	info@grescid.com
GRESPANIA, S.A.	(+34) 964 344 411	mail@grespania.com

Source: ASCER, 2011

Manufacturing firm	Phone Number	E-mail Address
GUIBOSA	(+34) 964 360 017	guibosa@guibosa.com
HALCON CERAMICAS	(+34) 964 367 367	global@halconceramicas.com
HERMANOS LLANSOLA, S.L.	(+34) 964 328 288	hermanosllansola@gmail.com
HISPAGREX	(+34) 964 329 261	hispagrex@hispagrex.es
HISPANIA CERAMICA, S.A.	(+34) 964 776 540	global@hispaniaceramica.com
IBERO ALCORENSE	(+34) 964 367 536	ibero@iberoceramica.com
INALCO	(+34) 964 368 000	correo@inalco.es
INCOAZUL	(+34) 964 361 190	porcelanite@porcelanite.es
JOSE OSET Y CIA, S.L.	(+34) 964 625 252	oset@oset.es
KERABEN GRUPO, S.A.	(+34) 964 659 500	keraben@kerabengrupo.com
KERAMEX, S.A.	(+34) 964 526 633	keramex@keramex.com
KERAMIA	(+34) 964 584 022	info@keramia.es
KEROS CERAMICA, S.A.	(+34) 964 673 000	email@keros.com
LA PLATERA DISTRIBUCIÒN, S.L.	(+34) 964 360 153	info@laplatera.es
LUCER	(+34) 964 381 200	lucer@lucer.es
MAINZU	(+34) 964 506 300	mainzu@mainzu.com
MARAZZI ESPAÑA	(+34) 964 349 000	nacional@marazzi.es
MAYOLICA AZULEJOS, S.L.	(+34) 964 360 275	comercial@mayolica.es
NATUCER, S.L.	(+34) 964 604 066	natucer@natucer.es
NAVARTI GRUPO, S.A.	(+34) 964 776 262	global@navarti.com
NOMAZUL, S.A.	(+34) 964 360 700	info@nomazul.es
NOVOGRES	(+34) 964 533 360	novogres@novogres.es
NUEVAS ATOMIZADAS, S.L.	(+34) 964 331 302	gerencia_natomizadas@akitania.net
NUEVOS PRODUCTOS CERAMICOS, S.A.	(+34) 964 329 353	gerencia@npcsa.com
ONDA KERAMIKOS, S.A.	(+34) 964 770 640	onda@keramikos.com
ONEKER	(+34) 964 219 700	cergom@ceramicagomez.com
ONIX MOSAICO	(+34) 964 776 287	onix@onixmosaic.com
PAMESA CERAMICA, S.L.	(+34) 964 507 500	export@pamesa.com
PAVIMBE	(+34) 964 620 300	pavimbe@pavimbe.com
PERONDA	(+34) 964 602 012	peronda@peronda.es
PLAZA CERAMICAS	(+34) 964 367 270	plaza@plazatiles.com
PORCELANITE DOS, S.L.	(+34) 964 361 190	porcelanite@porcelanite.es
PORCELANOSA, S.A.	(+34) 964 507 100	porcelanosa@porcelanosa.com
REALONDA	(+34) 964 776 500	realonda@realonda.com
ROCA	(+34) 93 8917600	info@rocatile.com
ROCERSA	(+34) 964 506 242	rocersa@rocersa.es
ROSA GRES	(+34) 93 5863060	rosagres@rosagres.com
SAGA CERAMICA, S.L.	(+34) 964 363 402	sagaceramica@sagaceramica.com

Source: ASCER, 2011

Manufacturing firm	Phone Number	E-mail Address
SALONI	(+34) 964 343 434	saloni@saloni.com
SAN GENIS	(+34) 93 8094004	info@san-genis.com
SIERRAGRES, S.A.	(+34) 957 364 060	sierragres@sierragres.com
STN CERAMICA	(+34) 964 672 812	stnceramica@stnceramica.es
SUPERCERAMICA, S.A.	(+34) 964 360 886	export@superceramica.com
TAU CERAMICA	(+34) 964 250 105	tau@tauceramica.com
TECNICERAMICA, S.A.	(+34) 964 361 177	tecniceramica@tecniceramica.es
TECNIGRES, S.A.	(+34) 964 701 010	ceramicas@aparici.com
TENDENCIAS CERAMICAS, S.L.	(+34) 964 331 910	info@tendenciasceramicas.com
TERRACOTA PAVIMENTOS DE GRES, S.A.	(+34) 964 522 551	exterior@terracota.com
TICSA	(+34) 93 6392900	ticsa@ticsa.net
TIERRA ATOMIZADA, S.A.	(+34) 964 367 800	info@tierraatomizada.com
TOGAMA, S.A.	(+34) 964 626 512	togama@togama.com
UNDEFASA	(+34) 964 360 250	undefasa@undefasa.com
UNICER	(+34) 964 367 100	comercial@unicer.com
VENIS, S.A.	(+34) 964 507 700	venis@venis.com
VENUS	(+34) 964 659 240	info@venus.es
VIVES AZULEJOS Y GRES, S.A.	(+34) 964 360 725	export@vivesceramica.com
ZIRCONIO, S.A.	(+34) 964 521 100	zirconio@zirconio.es

Source: ASCER, 2011

Annex II. IIA assumption

Multinomial probit regression, explaining the use of external knowledge sources in detriment of internal sources of knowledge

Variable	Category (2)		Category (3)		Category(4)	
	Estimate	p-value	Estimate	p-value	Estimate	p-value
Formalization of organizational processes	0.340	0.517	0.972	0.088*	-0.197	0.704
Decentralization of decision making	0.279	0.460	0.621	0.116	1.005***	0.006
Dynamic environment	-1.259*	0.07	-1.583**	0.034	-0.814	0.247
Competitive environment	-0.251	0.722	-0.427	0.550	-1.546**	0.022
Technological resources	0.110**	0.041	0.080	0.124	0.065	0.252
Size	1.949***	0.001	1.086**	0.052	2.031***	0.000
Group	-0.354	0.680	1.181	0.118	0.831	0.260
Age	0.030	0.207	0.041*	0.092	0.036	0.135

*p<0,10 **p<0,05 ***p<0,01

Reference category: 1

Number of observations: 101

Log-likelihood: -89.6480

Source: Authors' elaboration

Annex III. Marginal effects

Marginal effects from logit estimations

Variable	Category (1)	Category(2)	Category (3)	Category(4)
Formalization of organizational processes	-0.013	0.068	0.174	-0.229
Decentralization of decision making	-0.071	-0.138	0.008	0.216
Dynamic environment	0.105	-0.088	-0.131	0.113
Competitive environment	0.092	0.194	0.108	-0.394
Technological resources	-0.008	0.012	0.001	-0.005
Size	-0.183	0.079	-0.130	0.233
Group	-0.054	-0.225	0.144	0.135
Age	-0.004	-0.001	0.002	0.003

Source: Authors' elaboration

Annex IV. FIV Analyses

FIV analysis (I)

	Interaction effects	
	Exploitative Innovation	Exploratory innovation
Constant		
Acquisition of external knowledge	1.95	1.91
Technological resources	1.56	1.47
Decentralization	1.28	1.26
Formalization	1.11	1.10
Size	1.68	1.68
Age	1.13	1.14
Group	1.19	1.18
Acquisition of external knowledge x Technological resources	1.80	1.70
Acquisition of external knowledge x Decentralization	1.77	1.77
Acquisition of external knowledge x Formalization	1.23	1.23

Source: Authors' elaboration

FIV analysis (II)

	Knowledge search strategy
Constant	
Competitive environment	1,154
Dynamic environment	1,157
Decentralization	1,199
Formalization	1,028
Technological resources	1,044
Age	1,127
Group	1,167
Size	1,562

Source: Authors' elaboration

Annex V. Cuestionario

BLOQUE A. Organización, gestión y actividades de innovación

A.1.- Nivel de acuerdo (1=Totalmente en desacuerdo; 4= Totalmente de acuerdo) con las siguientes afirmaciones. En su empresa…

1.- Los empleados influyen significativamente en el diseño de las políticas y la organización del trabajo	1	2	3	4
2.- Los equipos de trabajo tienen autonomía para tomar decisiones	1	2	3	4
3.- Existen procedimientos formalizados para el desarrollo de las actividades de gestión y/o producción	1	2	3	4
4-. Se siguen de manera sistemática las normas y procedimientos establecidos	1	2	3	4
5-. Existen incentivos para que los empleados aporten nuevas ideas	1	2	3	4
6.- Existen incentivos para que los empleados actualicen o mejoren conocimientos y/o habilidades	1	2	3	4
7.- Existen procedimientos para recibir, cotejar y compartir información externa	1	2	3	4

A.2.- En su empresa, ¿con qué frecuencia… ***(1 = Nunca; 4 = Muy frecuentemente)***

1.- Se crean equipos de trabajo interdepartamentales	1	2	3	4
2.- Se rota a los empleados entre los diferentes departamentos/áreas	1	2	3	4
3.- Se organizan reuniones con clientes u otros agentes para adquirir conocimiento	1	2	3	4
4.- Se reciben revistas científico-técnicas	1	2	3	4
5.- Los empleados participan en foros, conferencias, jornadas técnicas	1	2	3	4
6.- Los empleados escriben artículos para revistas especializadas, congresos o jornadas técnicas	1	2	3	4

A.3.- Situación de su empresa con respecto a los siguientes aspectos
(1 = No dispone; 2 = Previsto su desarrollo; 3 = En proceso de desarrollo; 4 = Sí dispone)

1.- Sistema de vigilancia tecnológica y de mercado	1	2	3	4
2.-Certificación de calidad	1	2	3	4
3.- Plan de innovación	1	2	3	4
4.- Plan estratégico	1	2	3	4

5.- Intranet corporativa	1	2	3	4
6.- Sistema Integrado de Gestión (ERP)	1	2	3	4
7.- Sistema para la Administración de la Relación con los Clientes (CRM)	1	2	3	4

A.4.- ¿Ha desarrollado su empresa de forma *ocasional (1) o contínua* (2) alguna de las siguientes actividades de innovación durante los últimos tres años?: ***(ENSEÑAR TARJETA 1)***

A.5.- Distribución porcentual del gasto realizado durante el último año en innovación:

A.4 - Actividades	**.1**	**.2**	**A.5 (%)**
1.- I+D interna	1	2	
2.- I+D externa	1	2	
3.- Adquisición de maquinaria y equipo	1	2	
4.- Adquisición de hardware y/o software	1	2	
5.- Adquisición de otros conocimientos externos	1	2	
6.- Formación	1	2	
7.- Ingeniería y diseño internos	1	2	
8.- Acciones internas orientadas a cambios organizativos en la empresa	1	2	
9.- Acciones internas orientadas a introducir nuevos productos y/o abrir mercados nuevos	1	2	
10.- Consultoría externa	1	2	
			100%

A.6.- ¿Existe en su empresa Departamento Técnico o de I+D?:

SI	1	NO	2

A.7.- ¿En qué año fue creado?.....:

A.8.- Departamentos o áreas de su empresa que participan o han participado en actividades de I+D durante los últimos tres años:

	Si	No
1.- Áreas o departamentos relacionados con la producción	1	2
2.- Áreas o departamentos relacionados con el mercado	1	2
3.- Otros departamentos: _____	1	2

A.9.- Número total de empleados de su empresa...: | | | | |

A.10.- Porcentaje de empleados con formación universitaria: | | | % |

A.11.- Porcentaje de empleados dedicados a actividades de I+D: | | | % |

A.12.- Indique si durante los últimos tres años su empresa incorporó:

		Si	No
1.-	Ingenieros / licenciados de graduación reciente	1	2
2.-	Personal con experiencia en el sistema público de I+D	1	2
3.-	Personal con experiencia empresarial en I+D	1	2
4.-	Personal con experiencia en empresas del sector	1	2

A.13.- ¿Tienen registradas marcas, modelos de utilidad, patentes o programas informáticos?:

SI	1	No	2

A.14.- ¿Utiliza su empresa habitualmente la subcontratación en el proceso productivo?:

SI	1	No	2

A.15.- Porcentaje estimado que supone la subcontratación sobre la producción total: | | | %

A.16.- Los productos (bienes o servicios) de su empresa ¿son generados bajo licencia de patente o franquicia?:

SI	1	En parte	2	No	3

BLOQUE B. RELACIONES CON OTROS AGENTES

B.1.- ¿Ha establecido su empresa algún tipo de relación con alguno/s de los siguientes agentes durante los últimos tres años?:

B.2.- ¿En qué tipo/s de actividades?: ***(ENSEÑAR TARJETA 2)***

B.3.- Nivel de frecuencia de la relación: ***(1 = Bajo; 2 = Medio; 3 = Alto)***

B.4.- Factores importantes que influyeron en las relaciones con estos agentes: ***(ENSEÑAR TARJETA 3)***

B.5.- Ubicación/es geográfica/s de estos agentes: ***(1 = Local / Autonómico; 2 = Nacional; 3 = U. E.; 4 = Otros países)***

B.1.- Agentes			**B.2.- Actividades**									**B.3. Frecuencia**			**B.4.- Factores**						**B.5.- Ubicación**			
	Si	**No**	**.1**	**.2**	**.3**	**.4**	**.5**	**.6**	**.7**	**.8**	**.9**	**.1**	**.2**	**.3**	**.1**	**.2**	**.3**	**.4**	**.5**	**.6**	**.1**	**.2**	**.3**	**.4**
1.- Otras empresas del grupo	1	2	1	2	3	4	5	6	7	8	9	1	2	3	1	2	3	4	5	6	1	2	3	4
2.- Proveedores	1	2	1	2	3	4	5	6	7	8	9	1	2	3	1	2	3	4	5	6	1	2	3	4
3.- Clientes	1	2	1	2	3	4	5	6	7	8	9	1	2	3	1	2	3	4	5	6	1	2	3	4
4.- Competidores	1	2	1	2	3	4	5	6	7	8	9	1	2	3	1	2	3	4	5	6	1	2	3	4
5.- Consultores, laboratorios, institutos privados I+D	1	2	1	2	3	4	5	6	7	8	9	1	2	3	1	2	3	4	5	6	1	2	3	4
6.- Universidades	1	2	1	2	3	4	5	6	7	8	9	1	2	3	1	2	3	4	5	6	1	2	3	4
7.- Organismos públicos de investigación	1	2	1	2	3	4	5	6	7	8	9	1	2	3	1	2	3	4	5	6	1	2	3	4
8.- Centros tecnológicos	1	2	1	2	3	4	5	6	7	8	9	1	2	3	1	2	3	4	5	6	1	2	3	4

B.6.1.- ¿Cuáles de las empresas de la lista han prestado apoyo técnico a la suya?:

B.6.2.- ¿Y apoyo de mercado?:

B.7.1.- ¿A cuáles ha prestado su empresa apoyo técnico?:

B.7.2.- ¿Y apoyo de mercado?*: Importancia: 1 = Bajo; 2 = Medio; 3 = Alto*

LAS TABLAS REFERENTES A LAS PREGUNTAS B.6.1-B.7.2 SE ENCUENTRAN EN LA PÁGINA 171

Sólo si han señalado alguna relación en las preguntas b.6 o/y b.7

B.8.1.- Indique la frecuencia: *(1 = No más de una vez al año; 2 = Al menos una vez al trimestre; 3 = Al menos una vez al mes)*

B.8.2.- Indique la similitud: *(1 = Nada o poco parecida; 3 = Muy parecida) (ENSEÑAR TARJETA 4)*

LAS TABLAS REFERENTES A LAS PREGUNTAS B.8.1 Y B.8.2 SE ENCUENTRAN EN LA PÁGINA 172

B.9.- ¿Qué agentes o instituciones de fuera del distrito han prestado apoyo técnico (1) y/o de mercado (2) a su empresa?

B.10.- ¿Qué agentes o instituciones del distrito han prestado apoyo técnico (1) y/o de mercado (2) a su empresa?:

Niveles de importancia: 1 = Bajo; 2 = Medio; 3 = Alto

LAS TABLAS REFERENTES A LAS PREGUNTAS B.9 Y B.10 SE ENCUENTRAN EN LA PÁGINA 173

EMPRESAS	B61	B62	B71	B72
1. ADITIVOS CERÁMICOS				
2. AL FARBEN, S.A.				
3. APARICI				
4. ARGENTA				
5. AZTECA				
6. AZULEJOS MALLOL				
7. AZULEV				
8. AZULINDUS Y MARTÍ, S.A.				
9. BALDOCER, S.A.				
10. BARBIERI & TAROZZI				
11. CEBIS CERAMICAS, S.L.				
12. CERACASA, S.A.				
13. CERÁMICA BELCAIRE, S.A.				
14. CERAMICA NULENSE, S.A.				
15.CERAMICA SALONI, S.A.				
16. CERÁMICAS ALCALATÉN				
17. CERYPSA CERAMICAS, S.A.				
18. CHUMILLAS TARONGI, S.L.				
19. COLORES CERAMICOS, S.A.				
20. COLOR ESMALT				
21. COLORIFICIO CERAMICO BONET, S.A.				
22. COLORKER				
23. COLOROBBIA ESPANA, S.A.				
24. COLORONDA, S.L.				
25. CRETA PRINT, S.L.				
26. CRISTAL CERÁMICAS, S.A.				
27. CUCCOLINI IBÉRICA				
28. DECOCER				
29. ESMALDUR, S.A.				
30. ESMALGLASS, S.A.				
31. ESMALTES, S.A.				
32. ESTUDIO CERAMICO, S.L.				
33. EUROATOMIZAEDO, S.A.				
34. EXAGRES, S.A.				
35. FANAL				
36. FERRO SPAIN S.A.				
37. FRITTA, S.L.				
38. GARDENIA QUÍMICA				
39. GRES CID				
40. GRES DE ANDORRA, S.L.				
41. GRESPANIA				
42. HALCON CERAMICAS, S.A.				
43. IBERO ALCORENSE, S.L.				
44. INDUSTRIA CERAMICA ALCORENSE				
45. I.T.A.C.A., S.A.				

EMPRESAS	B61	B62	B71	B72
46. INTRASA				
47. JOHNSON MATTHEY CERAMICS, S.A.				
48. KERABEN, S.A.				
49. KERAFRIT				
50. KERAJET				
51. KEROS CERAMICA, S.A.				
52. LAMBERTI IBERIA, S.A.				
53. LA PLATERA, S.A.				
54. MAINCER				
55 MARAZZI.				
56. MINERARIA ESPAÑA, S.L.				
57. MOLCER, S.A.				
58. NATUCER				
59. NAVARTI CERAMICA, S.L.				
60. NOVOGRES				
61. NUEVOS PRODUCTOS CERAMICOS, S.A				
62. ONIX CERAMICA, S.L.				
63. PAMESA				
64. PASICOS, S.A.				
65. PLAZA CERÁMICAS				
66. PORCELANOSA, S.A.				
67. QUIMICER, S.A.				
68. ROIG CERAMICA, S.A.				
69. ROSAGRES				
70. SACMI				
71. SUM. IND. COGULLADA CASTELLON, SA				
72. SYSTEM ESPAÑA, S.A.				
73. TALLERES CORTES, S.L.				
74. TALLERES FORO, S.A.				
75. TAULELL, S.A.				
76.TECNIMOL, S.L.				
77. TECNOGRÁFICA				
78. TECNOPAMIC, S.A.				
79. TIERRA ATOMIZADA, S.A.				
80. TORRECID, S.A.				
81. TRES F DECORACIONES MANUALES, S.L.				
82. UNISYSTEMS, S.A.				
83. V.L. LIMITRONIC, S.L.				
84. VENIS, S.A.				
85. VENUS CERÁMICA, S.A.				
86. VIDRES, S.A.				
87. VIVES AZULEJOS Y GRES, S.A.				
88. WBB MINERALS				
89. ZSCHIMMER & SCHWARZ				

EMPRESAS	B81	B82
1. ADITIVOS CERÁMICOS		
2. AL FARBEN, S.A.		
3. APARICI		
4. ARGENTA		
5. AZTECA		
6. AZULEJOS MALLOL		
7. AZULEV		
8. AZULINDUS Y MARTÍ, S.A.		
9. BALDOCER, S.A.		
10. BARBIERI & TAROZZI		
11. CEBIS CERAMICAS, S.L.		
12. CERACASA, S.A.		
13. CERÁMICA BELCAIRE, S.A.		
14. CERAMICA NULENSE, S.A.		
15.CERAMICA SALONI, S.A.		
16. CERÁMICAS ALCALATÉN		
17. CERYPSA CERAMICAS, S.A.		
18. CHUMILLAS TARONGI, S.L.		
19. COLORES CERAMICOS, S.A.		
20. COLOR ESMALT		
21. COLORIFICIO CERAMICO BONET, S.A.		
22. COLORKER		
23. COLOROBBIA ESPANA, S.A.		
24. COLORONDA, S.L.		
25. CRETA PRINT, S.L.		
26. CRISTAL CERÁMICAS, S.A.		
27. CUCCOLINI IBÉRICA		
28. DECOCER		
29. ESMALDUR, S.A.		
30. ESMALGLASS, S.A.		
31. ESMALTES, S.A.		
32. ESTUDIO CERAMICO, S.L.		
33. EUROATOMIZAEDO, S.A.		
34. EXAGRES, S.A.		
35. FANAL		
36. FERRO SPAIN S.A.		
37. FRITTA, S.L.		
38. GARDENIA QUÍMICA		
39. GRES CID		
40. GRES DE ANDORRA, S.L.		
41. GRESPANIA		
42. HALCON CERAMICAS, S.A.		
43. IBERO ALCORENSE, S.L.		
44. INDUSTRIA CERAMICA ALCORENSE		
45. I.T.A.C.A., S.A.		
46. INTRASA		
47. JOHNSON MATTHEY CERAMICS, S.A.		

EMPRESAS	B.8.1	B.8.2
48. KERABEN, S.A.		
49. KERAFRIT		
50. KERAJET		
51. KEROS CERAMICA, S.A.		
52. LAMBERTI IBERIA, S.A.		
53. LA PLATERA, S.A.		
54. MAINCER		
55 MARAZZI.		
56. MINERARIA ESPAÑA, S.L.		
57. MOLCER, S.A.		
58. NATUCER		
59. NAVARTI CERAMICA, S.L.		
60. NOVOGRES		
61. NUEVOS PRODUCTOS CERAMICOS, S.A.		
62. ONIX CERAMICA, S.L.		
63. PAMESA		
64. PASICOS, S.A.		
65. PLAZA CERÁMICAS		
66. PORCELANOSA, S.A.		
67. QUIMICER, S.A.		
68. ROIG CERAMICA, S.A.		
69. ROSAGRES		
70. SACMI		
71. SUM. IND. COGULLADA CASTELLON, S.A.		
72. SYSTEM ESPAÑA, S.A.		
73. TALLERES CORTES, S.L.		
74. TALLERES FORO, S.A.		
75. TAULELL, S.A.		
76.TECNIMOL, S.L.		
77. TECNOGRÁFICA		
78. TECNOPAMIC, S.A.		
79. TIERRA ATOMIZADA, S.A.		
80. TORRECID, S.A.		
81. TRES F DECORACIONES MANUALES, S.L.		
82. UNISYSTEMS, S.A.		
83. V.L. LIMITRONIC, S.L.		
84. VENIS, S.A.		
85. VENUS CERÁMICA, S.A.		
86. VIDRES, S.A.		
87. VIVES AZULEJOS Y GRES, S.A.		
88. WBB MINERALS		
89. ZSCHIMMER & SCHWARZ		

INSTITUCIONES	B.9.1	B.9.2
1. AENOR		
2. BANCAJA		
3. CAJA AHORROS MEDITERRÁNEO - CAM		
4. CDTI		
5. COMISIÓN EUROPEA EMPRESA E INDUSTRI		
6. CONSELLERIA INDUS. COMERÇ INNOVACIÓ		
7. IMPIVA		
8. INSTITUTO COMERCIO EXTERIOR - ICEX		
9. INSTITUTO CRÉDITO OFICIAL - ICO		
10. INSTITUTO VAL. FINANZAS - IVF		
11 IVEX.		
12. MINISTERIO CIENCIA E INNOVACIÓN		
13. PRICE WATERHOUSE COOPERS		
14. SGS		
15. UNIVERSIDAD DE VALÈNCIA		
16. UNIVERSIDAD POLITÉCNICA VALÈNCIA		
17. UNIVERSIDAD DE ZARAGOZA		
18. UNIVERSIDAD DE BOLONIA		
19. UNIVERSIDAD DE MANRESA		
20. UNIVERSIDAD DE LA RIOJA		
21. UNIVERSIDAD CASTILLA LA MANCHA		
22. UNIVERSIDAD DE CÁDIZ		
23. UNIVERSIDAD DE BARCELONA		
24. AIDO		
25. AIMPLAS		
26. ITENE		
27. INSTITUTO VIDRIO CERÁMICA - MADRID		

INSTITUCIONES	B.10.1	B.10.2
1. ASCER		
2. ANNFFECC		
3. ASEBEC		
4 .ASOCIACIÓN TÉCNICOS CERÁMICOS - ATC		
5. U J I (DEPARTAMENTOS)		
6. INSTITUTO TECNOLOGÍA CERÁMICA - ITC		
7. ALICER		
8. FUE-UJI - FUNDACIÓN U J I - EMPRESA		
9. QUALICER		
10. CEVISAMA		
11. CÁMARA COMERCIO CASTELLÓ		
12. ESPAITEC – PARC TECNOLÓGIC UJI		
13. CEEI CASTELLÓ		
14. INSTITUTO PROMOCIÓN CERÁMICA-IPC		
15. ESCUELA SUPERIOR DE CERÁMICA DE L'ALCORA - ESCAL		
16. INSTITUTO DE CERÁMICA DE ONDA		

B.11.- Indique la situación en la que se encuentra su empresa:

	SI	N0
1.- En las contrataciones de personal técnico realizadas en los últimos 5 años, su empresa se ha limitado a publicar o anunciar la oferta de trabajo para después seleccionar a los candidatos según curriculum y entrevista personal.	1	2
2.- En las contrataciones de personal técnico realizadas en los últimos 5 años, su empresa ha realizado "fichajes" de empleados con formación y experiencia procedentes de otras empresas del sector.	1	2
3.- Considera que su empresa desarrolla acciones (salario, ventajas laborales, etc.) para evitar que trabajadores Y técnicos con experiencia cambien de empresa.	1	2
4.- Considera que su empresa valora más la experiencia que la formación en los procesos de selección y contratación de personal.	1	2

BLOQUE C. ESTRATEGIA DE EMPRESA Y ENTORNO EMPRESARIAL

C.1.- ¿Con qué frecuencia su empresa……*(1 = Nunca; 4 = Muy frecuentemente)*

1.- Es la primera en introducir nuevos productos (bienes o servicios) o procesos	1	2	3	4
2.- Realiza proyectos de alta incertidumbre técnico-económica	1	2	3	4

C.2.- Nivel de acuerdo con las siguientes afirmaciones: ***(1 = Nada de acuerdo; 4 = Totalmente de acuerdo)***

1.- Los cambios en nuestro mercado son intensos	1	2	3	4
2.- Nuestros clientes demandan regularmente nuevos productos y servicios	1	2	3	4
3.- El volumen de la demanda de bienes y servicios cambia con frecuencia	1	2	3	4
4.- La demanda de bienes y servicios innovadores es difícil de predecir.	1	2	3	4
5.- La competencia en nuestro mercado es intensa	1	2	3	4
6.- Nuestra empresa tiene fuertes competidores	1	2	3	4
7.- La competencia de precios es una característica de nuestro mercado	1	2	3	4
8.- La tecnología cambia rápidamente.	1	2	3	4
9.- Es difícil predecir los avances tecnológicos	1	2	3	4

BLOQUE D. RESULTADOS

D.1.- Durante los últimos tres años, ¿ha introducido su empresa alguna de estas innovaciones?:

D.2.- ¿Quién ha desarrollado estas innovaciones?: (1 = Principalmente su empresa; 2 = Su empresa en colaboración con otras empresas o instituciones; 3 = Principalmente otras empresas o instituciones) ***(ENSEÑAR TARJETA 5)***

	D.1.		**D.2.**		
	Si	**No**	**1**	**2**	**3**
<u>Innovaciones de Producto :</u>					
1.- Bienes y servicios nuevos o mejorados de los que ya disponían sus competidores	1	2	1	2	3
2.- Bienes y servicios nuevos o mejorados, antes que sus competidores	1	2	1	2	3
<u>Innovaciones de Proceso</u>:					
3.- Métodos de producción de bienes o servicios nuevos o mejorados	1	2	1	2	3
4.- Sistemas logísticos o métodos de entrega o distribución nuevos o mejorados	1	2	1	2	3
5.- Actividades de apoyo para sus procesos	1	2	1	2	3
<u>Innovaciones organizativas</u> :					
6.- Nuevas prácticas en la organización del trabajo o procedimientos de la empresa	1	2	1	2	3
7.- Nuevos métodos de organizar los lugares de trabajo para mejorar el reparto de responsabilidades y la toma de decisiones	1	2	1	2	3
8.- Nuevos métodos de gestión de relaciones externas con empresas o instituciones	1	2	1	2	3
9.- Nuevos sistemas de gestión del conocimiento interno y externo	1	2	1	2	3
<u>Innovaciones de comercialización</u> :					
10.- Modificaciones significativas en el diseño o/y envasado del producto	1	2	1	2	3
11.- Nuevas técnicas o canales para la promoción del producto	1	2	1	2	3
12.- Nuevos métodos para posicionar el producto en el mercado o canales de ventas	1	2	1	2	3
13.- Nuevos métodos para el establecimiento de los precios	1	2	1	2	3

D.3.- De las siguientes situaciones, ¿cuáles y en qué grado de intensidad se han dado en su empresa en los últimos tres años? ***(Niveles de intensidad: 1 = Bajo; 2 = Medio; 3 = Alto)***

1.- Ha penetrado en nuevos mercados	1	2	3
2.- Ha mejorado su cuota del mercado	1	2	3
3.- Ha mejorado la calidad de sus bienes y servicios	1	2	3
4.- Ha reducido los costes de producción	1	2	3
5.- Ha aumentado su capacidad de producción o prestación de servicios	1	2	3
6.- Ha mejorado su capacidad de respuesta a las necesidades de los clientes	1	2	3
7.- Ha mejorado la cualificación del personal	1	2	3
8.- Ha mejorado el intercambio de información dentro de la organización	1	2	3
9.- Ha Identificado nuevos mercados o nuevas oportunidades de negocio	1	2	3
10.- Ha explorado nuevas áreas tecnológicas	1	2	3
11.- Ha incrementado su beneficio	1	2	3
12.- Ha incrementado su cifra de negocios	1	2	3
13.- Ha mejorado su imagen y prestigio	1	2	3

D.4.- ¿Obtuvo ingresos por licencia o transferencia de tecnología en los últimos 3 años?:

SI	1	NO	2

D.5.- Porcentaje que representa sobre la facturación de su empresa el total de los gastos en actividades de innovación realizadas durante el último año:

0%	1	0-0,5%	2	0,5-1%	3	1-3%	4	3-10%	5	+10%	6

D.6.- Porcentajes de la facturación total de 2009 debidos a innovaciones de productos (bienes o servicios) introducidas en el período 2007-09 que fueron novedad…

D.6.1…sólo para la empresa:

0%	1	0-5%	2	5-10%	3	10-30%	4	30-50%	5	+50%	6

D.6.2… para el mercado:

0%	1	0-5%	2	5-10%	3	10-30%	4	30-50%	5	+50%	6

D.7.

- Reducción promedio en los costed de su empresa debido a innovaciones de proceso desarrolladas durante los últimos tres años | | | %

DATOS DE IDENTIFICACIÓN Y CLASIFICACIÓN

ENTREVISTADO / A:	CARGO:
E-MAIL:	TELÉFONO MÓVIL:

EMPLEADOS	Hasta 50	51-100	101-250	251-500	501-1000	Más de 1000
EMPRESA	1	2	3	4	5	6
GRUPO	1	2	3	4	5	6

EMPRESA:		N.I.F.:
C.P.:	MUNICIPIO:	TELÉFONO:
PÁGINA WEB:	FACTURACIÓN 2009:	

T A R J E T A 1

PREGUNTA A.4 - ACTIVIDADES DE INNOVACIÓN ÚLTIMOS TRES AÑOS

A.4.1.- I+D INTERNA: Trabajos realizados dentro de la empresa con el objetivo de generar nuevo conocimiento (científico o técnico) o de aplicar o aprovechar el conocimiento ya existente o desarrollado por otros.

A.4.2.- I+D EXTERNA: Las mismas actividades indicadas arriba, pero realizadas por otras organizaciones (incluidos otros grupos de empresas y organismos públicos o privados de investigación) y compradas por la empresa.

A.4.3.- ADQUISICIÓN DE MAQUINARIA Y EQUIPO: Compra de maquinaria avanzada o equipo especializado orientados a introducir innovaciones de producto, proceso, técnicas organizacionales o de comercialización.

A.4.5.- ADQUISICIÓN DE HARDWARE Y/O SOFTWARE, orientada a introducir innovaciones de producto, proceso, técnicas organizacionales o de comercialización.

A.4.6.- FORMACIÓN: Formación interna o externa del personal, destinada específicamente al desarrollo o introducción de innovaciones.

A.4.7.- INGENIERÍA Y DISEÑO INTERNOS: Incluyen todas las preparaciones técnicas para la producción y distribución no incluidas en I+D, así como los planos y gráficos para la definición de procedimientos, especificaciones técnicas y características operativas, instalación de maquinaria, ingeniería industrial y puesta en marcha de la producción.

A.4.8.- ACCIONES INTERNAS ORIENTADAS A CAMBIOS ORGANIZATIVOS EN LA EMPRESA: Generación, adaptación y aplicación de nuevas técnicas que permitan una mejor articulación de lo esfuerzos de cada área (coordinación entre producción, administración y ventas) y/o que permitan alcanzar de forma más eficiente los objetivos fijados.

A.4.9.- ACCIONES INTERNAS ORIENTADAS A LA INTRODUCCIÓN DE NUEVOS PRODUCTOS EN EL MERCADO Y/O A LA APERTURA DE NUEVOS MERCADOS.

A.4.10.- CONSULTORIA EXTERNA: Contratación con agentes externos de servicios científicos y técnicos relacionados con las actividades de ingeniería y diseño, cambios organizativos, introducción de nuevos productos y/o apertura de nuevos mercados.

T A R J E T A 2

P R E G U N T A B. 2 - A C T I V I D A D E S

B.2.1.- SOLICITUD DE FINANCIAMIENTO.

B.2.2.- CAPACITACIÓN.

B.2.3.- ASESORÍAS EN CAMBIO ORGANIZACIONAL.

B.2.4.- ASISTENCIA TÉCNICA.

B.2.5.- CONTRATACIÓN DE I+D.

B.2.6.- COOPERACIÓN EN I+D.

B.2.7.- COMPRA O USO, BAJO LICENCIA, DE PATENTES.

B.2.8.- INTERCAMBIO Y/O MOVILIDAD DE PERSONAL.

B.2.9.- OTRAS ACTIVIDADES.

T A R J E T A 3

P R E G U N T A B. 4 - F A C T O R E S

B.4.1.- REDUCIR LOS COSTES DE LAS ACTIVIDADES DE INNOVACIÓN

B.4.2.- ACCEDER A CAPACIDADES Y/O RECURSOS TÉCNICOS COMPLEMENTARIOS QUE PERMITAN FORTALECER LA LÍNEA DE NEGOCIO PRINCIPAL DE LA EMPRESA.

B.4.3.- ACCEDER A CAPACIDADES Y/O RECURSOS TÉCNICOS COMPLEMENTARIOS QUE FACILITEN LA EXPLORACIÓN DE NUEVAS ÁREAS TECNOLÓGICAS.

B.4.4.- ACCEDER A REDES DE CONOCIMIENTO CIENTÍFICO-TÉCNICO NO DISPONIBLE EN EL SECTOR EMPRESARIAL.

B.4.5.- ACCEDER A NUEVOS MERCADOS.

B.4.6.- GANAR MAYOR CREDIBILIDAD EN EL MERCADO.

T A R J E T A 4

P R E G U N T A B. 8. 2 - S I M I L I T U D

Se trata de valorar el grado de similitud de la empresa entrevistada con respecto a cada una de las empresas con las que tiene alguna relación de tipo técnico o comercial.

Para ello, la persona entrevistada debe considerar factores como cultura y valores empresariales, forma de trabajar, profesionalidad, organización del trabajo de su empresa en comparación con los que perciba de la otra empresa.

Una vez considerados todos estos factores se valorará entre 1 y 3 el grado de similitud / parecido, siendo:

1: la empresa entrevistada y aquella con la que se compara son nada o poco parecidas; 3: ambas son muy parecidas; el 2 sería un valor intermedio.

T A R J E T A 5

PREGUNTAS D.1 Y D.2 - INNOVACIONES ÚLTIMOS TRES AÑOS

INNOVACIONES DE PRODUCTO: Introducción en el mercado de bienes o servicios nuevos o significativamente mejorados con respecto a características básicas, especificaciones técnicas, software incorporado u otros componentes intangibles, finalidades deseadas o prestaciones. Los cambios de naturaleza meramente estética no deben ser tenidos en cuenta, así como la venta de innovaciones completamente producidas y desarrolladas por otras empresas.

INNOVACIONES DE PROCESO: Implantación de procesos de producción, métodos de distribución o actividades de apoyo a sus bienes y servicios que sean nuevos o que aporten una mejora significativa. Se excluyen las innovaciones meramente organizativas.

INNOVACIONES ORGANIZATIVAS: Implementación de nuevos métodos organizativos en el funcionamiento interno de la empresa, en la organización del lugar de trabajo o en las relaciones externas. Excluye fusiones o adquisiciones, aunque estas supongan una novedad organizativa para la empresa.

6.- Gestión de la cadena de suministro, sistemas de gestión del conocimiento, re-ingeniería de negocios, producción eficiente, gestión de la calidad, sistemas de educación y formación,…

7.- Uso por primera vez de un nuevo reparto de responsabilidades entre los empleados, gestión de equipos de trabajo, descentralización, reestructuración de departamentos,…

8.- Creación por primera vez de alianzas, asociaciones, externalización, subcontratación,…

INNOVACIONES DE COMERCIALIZACIÓN: Implementación de nuevas estrategias o conceptos comerciales que difieran significativamente de los anteriores y que no hayan sido utilizados con anterioridad; deben suponer un cambio significativo en el diseño o envasado del producto, así como en

su posicionamiento, promoció y precio. Excluye los cambios estacionales, regulares y otros cambios similares en los métodos de comercialización: estas innovaciones conllevan una búsqueda de nuevos mercados, pero no cambios en el uso del producto.

10.- Se excluyen los cambios que afectan a la funcionalidad del produto o las características del usuario; los cambios de funcionalidad serían innovación de producto.

11.- Uso por primera vez de un nuevo canal publicitario, creación de marcas nuevas para introducirse en nuevos mercados, introducción de tarjetas de fidelización de clientes,…

12.- Uso por primera vez de franquiciado o licencias de distribución, venta directa, venta al por menor en exclusiva, nuevos conceptos para la presentación del producto,…

13.- Uso por primera vez de un sistema de precios variables en función de la demanda, sistemas de descuento,…

Annex VI. Questionnaire

PART A. Organization, managemement and innovation activities

A.1.- Agreement level (1=Completely disagree; 4= Completely agree) with the following statements. In your company…

1.- Employees significantly influence on work policies and organization's design	1	2	3	4
2.- Working teams have autonomy for decision-making	1	2	3	4
3.- There are formalized procedures for management and/or production activities development	1	2	3	4
4-. The firm's norms and established procedures are systematically followed by the organization	1	2	3	4
5-. There are incentives for employees to contribute with new ideas	1	2	3	4
6.- There are incentives for employees to update their knowledge and skills	1	2	3	4
7.- There are procedures for receiving, contrasting, and sharing external information	1	2	3	4

A.2.- In your firm, ¿how often… ***(1 = Never; 4 = Very often)***

1.- Interdepartmental work teams are created	1	2	3	4
2.- Employees in different departments/areas are rotated	1	2	3	4
3.- Meetings with clients or another agents are organised in order to acquire knowledge	1	2	3	4
4.- Scientific/technical journals are received	1	2	3	4
5.- Employees participate in forums, conferences, technical workshops	1	2	3	4
6.- Employees write articles for specialised journals, conferences or technical workshops	1	2	3	4

A.3.- Company situation compared to the following aspects
(1 = Not available; 2 = Foreseen development; 3 = Under development process; 4 = Available)

1.- Technological and market vigilance system	1	2	3	4
2.-Quality Certification	1	2	3	4
3.- Innovation Plan	1	2	3	4
4.- Strategic Plan	1	2	3	4

5.- Corporate Intranet	1	2	3	4
6.- Enterprise Resource Planning System (ERP)	1	2	3	4
7.- Customer Relationship Management System (CRM)	1	2	3	4

A.4.- Has your company *occasionally (1) or continually (2)* developed any of the following innovation activities during the last three years?: *(SHOW CARD 1)*

A.5.- Percentage distribution of the expending made during the last year on innovation:

A.4 - Activities	**.1**	**.2**	**A.5 (%)**
1.- Internal R&D	1	2	
2.- External R&D	1	2	
3.- Machinery and equipment acquisition	1	2	
4.- Hardware and software adquisition	1	2	
5.- Acquisition of additional external knowledge	1	2	
6.-Training	1	2	
7.- Internal engineering and design	1	2	
8.- Internal actions oriented to organizational changes in the company	1	2	
9.- Internal actions oriented to introduce new products and/or open new markets	1	2	
10.- External consulting	1	2	
			100%

A.6.- ¿Does your company have a Technical /R&D Department?:

YES	1	NO	2

A.7.- ¿In which year was it created?.....:

A.8.- Departments or areas of your company that participate or have participated in R&D activities during the last three years:

	Yes	No
1.- Areas or departments related to production	1	2
2.- Areas or departments related to market	1	2
3.- Other departments: _____	1	2

A.9.- Total number of employees in your company...: | | | | |

A.10.- Percentage of employees with university degree: | | | %

A.11.- Percentage of employees dedicated to R&D activities: | | | %

A.12.- Indicate if during the last three days your company incorporated:

	Si	No
1.- Rencent engineers/undergraduates	1	2
2.- Personnel with experience in the public system of R&D	1	2
3.- Personnel with business experience on R&D	1	2
4.- Personnel with experience in companies from the sector	1	2

A.13.- Have you got registered brand, utility models, patents or IT programs?: SI 1 No 2

A.14.- Does your company usually utilize outsourcing in the production process?: SI 1 No 2

A.15.- Estimated percentage of outsourcing over total production: | | %

A.16.- Your company products (goods or services), are generated under patent license or franchise?: Yes 1 Partly 2 No 3

PART B. PARTNERSHIPS WITH EXTERNAL AGENTS

B.1.- Has your company established any kind if relationship with any of the following agents during the last three years?

B.2.- In what type of activities?: *(SHOW CARD 2)*

B.3.- Relationship frequency level: *(1 = Low ; 2 = Medium ; 3 = High)*

B.4.- Important factors that influenced on the relationship with these agents: *(SHOW CARD 3)*

B.5.- Geographic location/of these agents: *(1 = Local / Regional; 2 = National; 3 = U. E. ; 4 = Other countries)*

B.1.- Agents			B.2.- Activities									B.3. Frequency			B.4.- Factors						B.5.- Location			
	Si	No	.1	.2	.3	.4	.5	.6	.7	.8	.9	.1	.2	.3	.1	.2	.3	.4	.5	.6	.1	.2	.3	.4
1.- Other companies of the group	1	2	1	2	3	4	5	6	7	8	9	1	2	3	1	2	3	4	5	6	1	2	3	4
2.- Suppliers	1	2	1	2	3	4	5	6	7	8	9	1	2	3	1	2	3	4	5	6	1	2	3	4
3.- Clients	1	2	1	2	3	4	5	6	7	8	9	1	2	3	1	2	3	4	5	6	1	2	3	4
4.- Competitors	1	2	1	2	3	4	5	6	7	8	9	1	2	3	1	2	3	4	5	6	1	2	3	4
5.- Consultants, laboratorios or R&D private institutes	1	2	1	2	3	4	5	6	7	8	9	1	2	3	1	2	3	4	5	6	1	2	3	4
6.- Universities	1	2	1	2	3	4	5	6	7	8	9	1	2	3	1	2	3	4	5	6	1	2	3	4
7.- Public research bodies	1	2	1	2	3	4	5	6	7	8	9	1	2	3	1	2	3	4	5	6	1	2	3	4
8.- Technology centres	1	2	1	2	3	4	5	6	7	8	9	1	2	3	1	2	3	4	5	6	1	2	3	4

B.6.1.- Which of the listed companies have provided technical support to yours?

B.6.2.- And market support?

B.7.1.- Which of the listed companies has your company provided technical support to?

B.7.2.- And market support?*: Importance: 1 = Low; 2 = Medium; 3 = High*

TABLES REFERRING TO QUESTIONS B.6.1-B.7.2 ARE IN PAGE 171

Only answer in the case that you have marked any relation on questions B.6 and B.7

B.8.1.- Indicate the frequency: *(1 = No more than once per year; 2 = At least once per trimester; 3 =At least once per month)*

B.8.2.- Indicate the similarity: *(1 = Not/slightly similar; 3 = highly similar)*

(SHOW CARD 4)

TABLES REFERRING TO QUESTIONS B.8.1 AND B.8.2 ARE IN PAGE 172

B.9.- Which agents or institutions from out of the district have provided technical support (1) and/or market support (2) to your company?:

B.10.- **Which agents or institutions from the district have provided technical support (1) and/or market support (2) to your company?:**

Importance: 1 = Low; 2 = Medium; 3 = High

TABLES REFERRING TO QUESTIONS B.9 Y B.10 ARE IN PAGE 173

COMPANIES	B61	B62	B71	B72
1. ADITIVOS CERÁMICOS				
2. AL FARBEN, S.A.				
3. APARICI				
4. ARGENTA				
5. AZTECA				
6. AZULEJOS MALLOL				
7. AZULEV				
8. AZULINDUS Y MARTÍ, S.A.				
9. BALDOCER, S.A.				
10. BARBIERI & TAROZZI				
11. CEBIS CERAMICAS, S.L.				
12. CERACASA, S.A.				
13. CERÁMICA BELCAIRE, S.A.				
14. CERAMICA NULENSE, S.A.				
15.CERAMICA SALONI, S.A.				
16. CERÁMICAS ALCALATÉN				
17. CERYPSA CERAMICAS, S.A.				
18. CHUMILLAS TARONGI, S.L.				
19. COLORES CERAMICOS, S.A.				
20. COLOR ESMALT				
21. COLORIFICIO CERAMICO BONET, S.A.				
22. COLORKER				
23. COLOROBBIA ESPANA, S.A.				
24. COLORONDA, S.L.				
25. CRETA PRINT, S.L.				
26. CRISTAL CERÁMICAS, S.A.				
27. CUCCOLINI IBÉRICA				
28. DECOCER				
29. ESMALDUR, S.A.				
30. ESMALGLASS, S.A.				
31. ESMALTES, S.A.				
32. ESTUDIO CERAMICO, S.L.				
33. EUROATOMIZAEDO, S.A.				
34. EXAGRES, S.A.				
35. FANAL				
36. FERRO SPAIN S.A.				
37. FRITTA, S.L.				
38. GARDENIA QUÍMICA				
39. GRES CID				
40. GRES DE ANDORRA, S.L.				
41. GRESPANIA				
42. HALCON CERAMICAS, S.A.				
43. IBERO ALCORENSE, S.L.				
44. INDUSTRIA CERAMICA ALCORENSE				
45. I.T.A.C.A., S.A.				

COMPANIES	B61	B62	B71	B72
46. INTRASA				
47. JOHNSON MATTHEY CERAMICS, S.A.				
48. KERABEN, S.A.				
49. KERAFRIT				
50. KERAJET				
51. KEROS CERAMICA, S.A.				
52. LAMBERTI IBERIA, S.A.				
53. LA PLATERA, S.A.				
54. MAINCER				
55 MARAZZI.				
56. MINERARIA ESPAÑA, S.L.				
57. MOLCER, S.A.				
58. NATUCER				
59. NAVARTI CERAMICA, S.L.				
60. NOVOGRES				
61. NUEVOS PRODUCTOS CERAMICOS, S.A				
62. ONIX CERAMICA, S.L.				
63. PAMESA				
64. PASICOS, S.A.				
65. PLAZA CERÁMICAS				
66. PORCELANOSA, S.A.				
67. QUIMICER, S.A.				
68. ROIG CERAMICA, S.A.				
69. ROSAGRES				
70. SACMI				
71. SUM. IND. COGULLADA CASTELLON, SA				
72. SYSTEM ESPAÑA, S.A.				
73. TALLERES CORTES, S.L.				
74. TALLERES FORO, S.A.				
75. TAULELL, S.A.				
76.TECNIMOL, S.L.				
77. TECNOGRÁFICA				
78. TECNOPAMIC, S.A.				
79. TIERRA ATOMIZADA, S.A.				
80. TORRECID, S.A.				
81. TRES F DECORACIONES MANUALES, S.L.				
82. UNISYSTEMS, S.A.				
83. V.L. LIMITRONIC, S.L.				
84. VENIS, S.A.				
85. VENUS CERÁMICA, S.A.				
86. VIDRES, S.A.				
87. VIVES AZULEJOS Y GRES, S.A.				
88. WBB MINERALS				
89. ZSCHIMMER & SCHWARZ				

COMPANIES	B81	B82
1. ADITIVOS CERÁMICOS		
2. AL FARBEN, S.A.		
3. APARICI		
4. ARGENTA		
5. AZTECA		
6. AZULEJOS MALLOL		
7. AZULEV		
8. AZULINDUS Y MARTÍ, S.A.		
9. BALDOCER, S.A.		
10. BARBIERI & TAROZZI		
11. CEBIS CERAMICAS, S.L.		
12. CERACASA, S.A.		
13. CERÁMICA BELCAIRE, S.A.		
14. CERAMICA NULENSE, S.A.		
15.CERAMICA SALONI, S.A.		
16. CERÁMICAS ALCALATÉN		
17. CERYPSA CERAMICAS, S.A.		
18. CHUMILLAS TARONGI, S.L.		
19. COLORES CERAMICOS, S.A.		
20. COLOR ESMALT		
21. COLORIFICIO CERAMICO BONET, S.A.		
22. COLORKER		
23. COLOROBBIA ESPANA, S.A.		
24. COLORONDA, S.L.		
25. CRETA PRINT, S.L.		
26. CRISTAL CERÁMICAS, S.A.		
27. CUCCOLINI IBÉRICA		
28. DECOCER		
29. ESMALDUR, S.A.		
30. ESMALGLASS, S.A.		
31. ESMALTES, S.A.		
32. ESTUDIO CERAMICO, S.L.		
33. EUROATOMIZAEDO, S.A.		
34. EXAGRES, S.A.		
35. FANAL		
36. FERRO SPAIN S.A.		
37. FRITTA, S.L.		
38. GARDENIA QUÍMICA		
39. GRES CID		
40. GRES DE ANDORRA, S.L.		
41. GRESPANIA		
42. HALCON CERAMICAS, S.A.		
43. IBERO ALCORENSE, S.L.		
44. INDUSTRIA CERAMICA ALCORENSE		
45. I.T.A.C.A., S.A.		
46. INTRASA		
47. JOHNSON MATTHEY CERAMICS, S.A.		

COMPANIES	B.8.1	B.8.2
48. KERABEN, S.A.		
49. KERAFRIT		
50. KERAJET		
51. KEROS CERAMICA, S.A.		
52. LAMBERTI IBERIA, S.A.		
53. LA PLATERA, S.A.		
54. MAINCER		
55 MARAZZI.		
56. MINERARIA ESPAÑA, S.L.		
57. MOLCER, S.A.		
58. NATUCER		
59. NAVARTI CERAMICA, S.L.		
60. NOVOGRES		
61. NUEVOS PRODUCTOS CERAMICOS, S.A.		
62. ONIX CERAMICA, S.L.		
63. PAMESA		
64. PASICOS, S.A.		
65. PLAZA CERÁMICAS		
66. PORCELANOSA, S.A.		
67. QUIMICER, S.A.		
68. ROIG CERAMICA, S.A.		
69. ROSAGRES		
70. SACMI		
71. SUM. IND. COGULLADA CASTELLON, S.A.		
72. SYSTEM ESPAÑA, S.A.		
73. TALLERES CORTES, S.L.		
74. TALLERES FORO, S.A.		
75. TAULELL, S.A.		
76.TECNIMOL, S.L.		
77. TECNOGRÁFICA		
78. TECNOPAMIC, S.A.		
79. TIERRA ATOMIZADA, S.A.		
80. TORRECID, S.A.		
81. TRES F DECORACIONES MANUALES, S.L.		
82. UNISYSTEMS, S.A.		
83. V.L. LIMITRONIC, S.L.		
84. VENIS, S.A.		
85. VENUS CERÁMICA, S.A.		
86. VIDRES, S.A.		
87. VIVES AZULEJOS Y GRES, S.A.		
88. WBB MINERALS		
89. ZSCHIMMER & SCHWARZ		

COMPANIES	B.9.1	B.9.2
1. AENOR		
2. BANCAJA		
3. CAJA AHORROS MEDITERRÁNEO - CAM		
4. CDTI		
5. COMISIÓN EUROPEA EMPRESA E INDUSTRI		
6. CONSELLERIA INDUS. COMERÇ INNOVACIÓ		
7. IMPIVA		
8. INSTITUTO COMERCIO EXTERIOR - ICEX		
9. INSTITUTO CRÉDITO OFICIAL - ICO		
10. INSTITUTO VAL. FINANZAS - IVF		
11 IVEX.		
12. MINISTERIO CIENCIA E INNOVACIÓN		
13. PRICE WATERHOUSE COOPERS		
14. SGS		
15. UNIVERSIDAD DE VALÈNCIA		
16. UNIVERSIDAD POLITÉCNICA VALÈNCIA		
17. UNIVERSIDAD DE ZARAGOZA		
18. UNIVERSIDAD DE BOLONIA		
19. UNIVERSIDAD DE MANRESA		
20. UNIVERSIDAD DE LA RIOJA		
21. UNIVERSIDAD CASTILLA LA MANCHA		
22. UNIVERSIDAD DE CÁDIZ		
23. UNIVERSIDAD DE BARCELONA		
24. AIDO		
25. AIMPLAS		
26. ITENE		
27. INSTITUTO VIDRIO CERÁMICA - MADRID		

COMPANIES	B.10.1	B.10.2
1. ASCER		
2. ANNFFECC		
3. ASEBEC		
4 .ASOCIACIÓN TÉCNICOS CERÁMICOS - ATC		
5. U J I (DEPARTAMENTOS)		
6. INSTITUTO TECNOLOGÍA CERÁMICA - ITC		
7. ALICER		
8. FUE-UJI - FUNDACIÓN U J I - EMPRESA		
9. QUALICER		
10. CEVISAMA		
11. CÁMARA COMERCIO CASTELLÓ		
12. ESPAITEC – PARC TECNOLÓGIC UJI		
13. CEEI CASTELLÓ		
14. INSTITUTO PROMOCIÓN CERÁMICA-IPC		
15. ESCUELA SUPERIOR DE CERÁMICA DE L'ALCORA - ESCAL		
16. INSTITUTO DE CERÁMICA DE ONDA		

B.11.- Indicate the situation of your company:

	SI	N0
1.- In hiring processes for technical personnel developed during the last 5 years, your company has exclusively released or announced the job offer to select the candidates according to curriculum and a personal interview.	1	2
2.- In hiring processes for technical personnel developed during the last 5 years, your company has done "recruitments" of employees with training and experience coming from other companies in the sector.	1	2
3.- You consider that your company develops actions (salary, other advantages, etc.) to avoid company shifting of experienced employees and technicians.	1	2
4.- You consider that your company values more experience than training on selection and hiring processes.	1	2

PART C. BUSINESS STRATEGY AND ENVIRONMENTAL CONTEXT

C.1.- ¿How often your company……*(1 = Never; 4 = Very frequently)*

1.- Is the first one to introduce new products (goods or services) or processes	1	2	3	4
2.- Develops projects of high technic-economic uncertainty	1	2	3	4

C.2.- Agreement level with the following statements: *(1 = Totally disagree; 4 = Totally agree)*

1.- Changes in our market are intense	1	2	3	4
2.- Our clients regularly demand new products and services	1	2	3	4
3.- Products and services demand volume frequently changes	1	2	3	4
4.- Innovative products and services demand is difficult to forecast	1	2	3	4
5.- Competence in our market is intense	1	2	3	4
6.- Our company has strong competitors	1	2	3	4
7.- Price competition is a characteristic of our market	1	2	3	4
8.- Technology changes rapidly	1	2	3	4
9.- Technological breakthroughs are difficult to forecast	1	2	3	4

PART D. RESULTS

D.1.- During the last three years, has your company introduced any of these innovations?:

D.2.- Who has developed these innovations?: (1 = Mainly your company; 2 = Your company in collaboration with other companies or institutions; 3 = Mainly other companies or institutions) ***(SHOW CARD 5)***

	D.1.		**D.2.**		
	Yes	**No**	**1**	**2**	**3**
Product innovations :					
1.- New or improved goods and services already available by your competitors	1	2	1	2	3
2.- New or improved goods and services developed before your competitors	1	2	1	2	3
Process innovations:					
3.- New or improved production methods	1	2	1	2	3
4.- New or improved logistic systems or delivering methods or distribution	1	2	1	2	3
5.- Support activities for processes	1	2	1	2	3
Organizational innovations :					
6.- New work organization or procedures practices	1	2	1	2	3
7.- New methods to organise work places to improve responsibility sharing and the decision making process	1	2	1	2	3
8.- New methods to manage external relations with companies or institutions	1	2	1	2	3
9.- New internal or external knowledge management systems	1	2	1	2	3
Marketing innovations :					
10.- Significant modifications on product design and /or packaging	1	2	1	2	3
11.- New technics or channels for product promotion	1	2	1	2	3
12.- New methods to place the product in the market or in sales channels	1	2	1	2	3
13.- New methods for price establishment	1	2	1	2	3

D.3.- From the following situations, which ones and in which intensity have taken place in your company during the last three years?: *(Intensity levels : 1 = Low ; 2 = Medium ; 3 = High)*

1.- New markets have been accessed	1	2	3
2.- Market share has been improved	1	2	3
3.- Goods and services quality has been improved	1	2	3
4.- Productions costs have been improved	1	2	3
5.- Production capacity or services providing has been improved	1	2	3
6.- Response to clients needs has been improved	1	2	3
7.- Personnel qualification has been improved	1	2	3
8.- Information interchange in the organisation has been improved	1	2	3
9.- New markets or new business opportunities have been identified	1	2	3
10.- New technological areas have been explored	1	2	3
11.- Profits have been increased	1	2	3
12.- Sales have increased	1	2	3
13.- Image and prestige have been improved	1	2	3

D.4.- Did your company obtain incomes from licenses or technology transfer in the last three years?:

YES	1	NO	2

D.5.- Percentage that represents over the company turnover the total innovation expenses during the last year :

0%	1	0-0,5%	2	0,5-1%	3	1-3%	4	3-10%	5	+10%	6

D.6.- Percentage of total turnover for 2009 due to product innovations (goods and services) introduced in the period 2007-09 that were novel…

D.6.1…for the company:

0%	1	0-5%	2	5-10%	3	10-30%	4	30-50%	5	+50%	6

D.6.2… for the market:

0%	1	0-5%	2	5-10%	3	10-30%	4	30-50%	5	+50%	6

D.7.- Average company costs reduction due to process innovations developed during the last three years: | | | %

IDENTIFICATION DATA

COMPANY:		I.D.:
P.C.:	CITY:	PHONE:
WEB SITE:		TURNOVER 2009:

INTERVIEWEE:	POSITION:
E-MAIL:	PHONE NUMBER:

EMPLOYEES	Up to 50	51-100	101-250	251-500	501-1000	More than 1000
COMPANY	1	2	3	4	5	6
GROUP	1	2	3	4	5	6

CARD 1

QUESTION A.4 - INNOVATION ACTIVITIES DURING THE LAST THREE YEARS

A.4.1.- INTERNAL R&D: Tasks developed inside the company with the objective of generating new knowledge (scientific or technical) or to employ or take advantage of already existing knowledge or knowledge developed by others.

A.4.2.- EXTERNAL R&D: The same activities stated above, but developed by another organisations and bought by the company.

A.4.3.- MACHINERY AND EQUIPMENT ACQUISITION: Buying of advanced machinery or specialised equipment oriented to introduce product, process, organisational or marketing innovations.

A.4.5.- HARDWARE AND/OR SOFTWARE ACQUISITION: Oriented to introduce product, process, organisational or marketing innovations.

A.4.6.- TRAINING: Internal or external training, specifically intended for the introduction and development of innovations.

A.4.7.- INTERNAL ENGINEERING AND DESIGN: Includes all the technical preparations for production and distribution not included in R&D, such as plans and graphics for the procedures description, technical specifications and operational characteristics, machinery installation, industrial engineering and production starting up.

A.4.8.- INTERNAL ACTIONS ORTIENTED TO ORGANISATIONAL CHANGES IN THE COMPANY: Generation, adaptation and implementation of new technics which allows better coordination of areas (i.e. production, administration and sales) and/or which allows to comply in a more efficient way the established objectives.

A.4.9.- INTERNAL ACTIONS ORIENTED TO THE INTRODUCTIONS OF NEW PRODUCTS INTO THE MARKET AND/OR TO NEW MARKET OPENINGS

A.4.10.- EXTERNAL CONSULTING: Contracting to external agents scientific and technical services related to engineering and design activities, organisational changes, new products introduction and/or opening of new markets.

CARD 2

QUESTION B. 2 - ACTIVITIES

B.2.1.- FINANCIAL REQUEST

B.2.2.- TRAINING

B.2.3.- CONSULTING ON ORGANISATIONAL CHANGE

B.2.4.- TECHNICAL ASSITANCE

B.2.5.- R&D CONTRACTING

B.2.6.- R&D COOPERATING

B.2.7.- BUY OR USE, UNDER LISENCE, OF PATENTS

B.2.8.- PERSONNEL INTERCHANGE AND/OR MOBILITY

B.2.9.- OTHER ACTIVITIES

CARD 3

QUESTION B. 4 - F A C T O R S

B.4.1.- REDUCE INNOVATION ACTIVITIES COSTS

B.4.2.- ACCESS TO COMPLEMENTARY RESOURCES ALLOWING IMPROVEMENTS TO THE FIRM'S MAIN BUSINESS LINES

B.4.3.- ACCESS TO COMPLEMENTARY RESOURCES FACILITATING THE EXPLORATION OF NEW TECHNOLOGICAL AREAS

B.4.4.- ACCESS TO UNAVAILABLE SCIENTIFIC-TECHNICAL KNOWLEDGE NETWORKS IN THE BUSINESS SECTOR

B.4.5.- ACCESS TO NEW MARKETS

B.4.6.- OBTAIN MORE CREDIBILITY IN THE MARKET

CARD 4

QUESTION B. 8. 2 - SIMILARITY

The objective is to evaluate the interviewed company similarity level in contrast to each of the other companies, when any kind of technical or commercial relation exists.

For this, the interviewee must consider factors such as culture and business values, way of working, professionalism, and organisation of its company in contrast to its perception of the other company.

Once considered all this factors, the similarity/closeness level will be valued between 1 and 3, being:

1: The interviewed company and the compared one are not or barely alike; 3: both are very similar; 2 would be an intermediate value.

CARD 5

QUESTIONS D.1 AND D.2 - LAST THREE YEARS INNOVATIONS

PRODUCT INNOVATIONS: Introduction in the market of new or significantly improved goods or services with respect to basic characteristics, technical specifications, incorporated software or other intangible components, desired purposes. Mere aesthetic changes must not be taken into account, or the selling of innovations completely produced and developed by other companies.

PROCESS INNOVATIONS: Implementation of production processes, distribution methods or support activities to goods and services, which are new or provide a significant improvement. Mere organisational innovations are excluded.

ORGANISATIONAL INNOVATIONS: Implementation of new organisational methods in the internal functioning of the company, in the work place organisation or in the external relations. Mergers, acquisitions are excluded, even though these imply an organisational novelty for the company.

6.- Supply chain management, knowledge management systems, business re-engineering, efficient production, quality management, education and training systems,…

7.- Utilisation for the first time of a new responsibilities sharing within employees, work team management, decentralisation, department restructuration,...

8.- Creation for the first time of alliances, associations, externalisation, outsourcing …

MARKETING INNOVATIONS: Implementation of new strategies or commercial concepts that significantly differ from previous ones and that have not been used before. It must suppose a significant change on the product design or packaging, also on placement, promotion and price. Exclude seasonable, regular and other similar changes in commercialisation methods: these innovations search for new markets, but not changes in the products use.

10.- Changes that affect the product functionality or user characteristics are excluded; functionality changes would be product innovation.

11.- The use for the first time of a new advertising channel, creation of new brands in order to access new markets, introduction of clients fidelity cards …

12.- The use for the first time of a franchised or distribution licence, direct sales, exclusivity retail sales, new concepts for product presentation, ...

13.- The use for the first time of a variable price system according to demand, discount systems, …