



# Can formalization, complexity, and centralization influence knowledge performance?

Eva M. Pertusa-Ortega<sup>\*</sup>, Patrocinio Zaragoza-Sáez, Enrique Claver-Cortés

University of Alicante, Department of Business, San Vicente del Raspeig Campus, P.O. Box 99, 03080 Alicante, Spain

## ARTICLE INFO

### Article history:

Received 1 March 2008

Received in revised form 1 February 2009

Accepted 1 March 2009

### Keywords:

Formalization

Complexity

Centralization

Knowledge performance

Knowledge management

## ABSTRACT

Based on the theory of organizational design and on the theory of knowledge, this paper analyzes how the traditional variables which define a firm's organizational structure (formalization, complexity, and centralization) influence knowledge performance (the degree to which a firm generates knowledge internally and uses it to reach a competitive advantage). The paper tests three hypotheses using a sample of 164 large Spanish firms. The results show that organizational complexity and centralization exert a positive and a negative influence, respectively, on knowledge performance, which confirms the two hypotheses related to these variables. However, the analysis reveals no empirical evidence to confirm the hypothesis according to which formalization and knowledge performance have a positive relationship.

© 2009 Elsevier Inc. All rights reserved.

## 1. Introduction

As world economies evolve, business success is coming to depend more and more on knowledge, which now is not only a basic factor of production (Drucker, 1993) but also a business in its own right (Tissen et al., 2000). Competencies, capabilities, routines (Feldman and Pentland, 2003) or innovation (Un and Cuervo-Cazurra, 2004) are some of the most commonly-used terms to refer to knowledge in the context of business.

Firms must manage knowledge properly if they are to derive its benefits. The introduction of processes for managing knowledge can help firms in their efforts to integrate newly acquired or generated knowledge into the products and services they offer, with the ultimate aim of obtaining a competitive advantage (Nonaka and Takeuchi, 1995). This study uses the term 'knowledge performance' to denote the extent to which a firm generates knowledge internally and applies it to achieve a competitive advantage.

Organizational structure plays a key role in knowledge management regarding the development, transfer and use of knowledge (Lam, 2000; Nonaka and Takeuchi, 1995), because it can facilitate the coordination of all the elements inside the organization so that the latter can fulfill its objectives (Mintzberg, 1979). The purpose of the study reported herein is to analyze how the traditional variables defining the structure of an organization (i.e. formalization, complexity, and centralization) influence knowledge performance.

There are three motivations for this purpose. The first one concerns the fact that, although various studies have focused on the new organizational forms that should prevail in the knowledge-based economy to make knowledge management easy (Lam, 2000; Nonaka and Takeuchi, 1995; Hedlund, 1994; Handy, 1992), only a few of them have examined empirically the link between the traditional characteristics of organizational structure and knowledge management.

The second motivation is that a number of recent studies have paid attention to the micro-organizational features which are likely to help knowledge management. Most focus on the interaction of individuals or the characteristics of the specific task they have to perform (Becerra-Fernandez and Sabherwal, 2001) or on work teams (Power and Waddell, 2004; Forrester, 2000). Others concentrate on the analysis of inter-organizational relationships, such as strategic alliances (Nielsen, 2005; Norman, 2004) or network organizations (Mandeville, 2005), from a mainly theoretical point of view. One can thus identify a lack of empirical studies having firms' organizational structure as their unit of analysis.

The third motivation is that there is no linkage researched between a firm's organizational structure and knowledge performance. The knowledge transfer process has been studied extensively (Okhuysen and Eisenhardt, 2002; Szulanski, 1996) whereas the extent to which a firm generates knowledge and applies it to achieve a competitive advantage—knowledge performance—does not seem to have received any attention.

Moreover, the study focuses not only on knowledge-intensive sectors, such as engineering or those concerned with new technologies, but on a multi-sector sample because, as Baskerville and Dulipovici (2006) explain, a knowledge organization is not necessarily a knowledge-intensive one (which is different from capital- or labor-

<sup>\*</sup> Corresponding author.

E-mail addresses: [eva.pertusa@ua.es](mailto:eva.pertusa@ua.es) (E.M. Pertusa-Ortega), [patrocinio.zaragoza@ua.es](mailto:patrocinio.zaragoza@ua.es) (P. Zaragoza-Sáez), [enrique.claver@ua.es](mailto:enrique.claver@ua.es) (E. Claver-Cortés).

intensive firms in that knowledge is the most important organizational input). Furthermore, although smaller firms theoretically seem to be more flexible when implementing procedures to manage knowledge (Lei et al., 1999), this paper focuses on large firms.

The structure of the paper is as follows. The next section contains a review of the literature on knowledge performance and organizational structure. This review serves as the basis for the formulation of three hypotheses. The following section describes the study methods, after which is the presentation and discussion of the results. The final section offers the main conclusions, draws implications and makes suggestions for further research.

## 2. Literature review and hypotheses

### 2.1. Knowledge performance

The knowledge-based view of the firm started to emerge in the mid-1990s (Zack, 1999; Grant, 1996; Spender, 1996) as an extension of the resource-based view (Peteraf, 1993; Barney, 1991; Wernerfelt, 1984). The resource-based view considers that the heterogeneity of firms' resources and capabilities can lead to different profitability levels, whereas the knowledge-based view focuses on knowledge seen as one of the firm's most important resources in strategic terms. Some authors focus on knowledge as an input or resource that firms can transfer, recombine, license or use (Eisenhardt and Santos, 2001). Knowledge originates from creativity, individual experiences and organizational learning, and appears in written documents as well as in the routines, tasks, processes, practices, rules and values that shape an organization (Bhagat et al., 2002). Knowledge results from the interactions between individuals and organizations, and is specific to a context defined according to some particular time and place circumstances (Nonaka et al., 2000; Hayek, 1945).

Due to the importance of knowledge, knowledge management has become a fundamental task and one of the challenges of our time. Its global aim is both to maximize the company's effectiveness and income levels arising from its knowledge assets and to succeed in constantly renewing them (Wiig, 1997). From the contributions made by various authors, among whom stand out Davenport, De Long, and Beers (1998), Quintas, Lefrere, and Jones (1997) and Nonaka and Takeuchi (1995), knowledge management can be defined as the set of business actions undertaken to aid the creation and/or acquisition of knowledge, its transfer to all members of the company and its subsequent application with the aim of achieving distinctive competencies that provide the company with a long term competitive advantage. The effectiveness of knowledge management processes may depend on the firm's absorptive capacity, which impacts on both the creation and/or acquisition of knowledge as well as on its transfer (Von Krogh et al., 2000; Gupta and Govindarajan, 2000; Nonaka et al., 2000). Cohen and Levinthal (1990, p. 128) define absorptive capacity as the "ability of a firm to recognize the value of new information, assimilate it, and apply it to commercial ends" (in accordance with the purpose of this paper, one can understand information as knowledge in this definition).

Knowledge in a business enterprise can appear as (a) inputs to a production process, and as (b) outputs of a knowledge management process (Postrel, 2002). In the present paper, the use of the term knowledge performance refers to the second option. Starting from the assumption that not all the knowledge created and/or acquired

ultimately serves to obtain new outputs (Leibenstein, 1966), this study considers that knowledge performance is the result of knowledge management. More precisely, the term knowledge performance refers to the knowledge created internally (as a result of learning, exploration, knowledge-sharing, etc.) and finally applied to generate new products and/or services that add value to the customer and permit to improve the firm's competitive position (Ahn et al., 2006; Un and Cuervo-Cazurra, 2004; Power and Waddell, 2004) (see Fig. 1).

Thus, taking as a reference the resource-based view, which studies how resources and capabilities can provide the firm with a competitive advantage, this paper analyzes the possible influence of formalization, complexity, and centralization on the creation and application of knowledge (regarded as the most important strategic resource) seeking to improve knowledge performance and the firm's competitive position.

One can find an example of knowledge performance in the new product development processes, since these processes include the generation and application of new ideas in new products (Ahn et al., 2006; Söderquist, 2006). Nevertheless, knowledge performance is a broader concept which includes not only new product development but also those processes or assets that improve product quality or permit to offer customers a higher level of attention and a quick response to their demands.

Achieving an adequate feedback about the knowledge management processes will be possible if the firm knows its degree of knowledge performance. This information will allow the organization to adopt correcting methods when the degree of knowledge performance is low, and boosting methods when that degree is appropriate. Likewise, it may prove useful for the firm to check whether the resources invested in knowledge management processes are providing satisfactory results.

### 2.2. Organizational structure

Firms must design structures and systems that facilitate the flow of knowledge so that the organization can create, accumulate, integrate, and disseminate, and hence manage, this resource effectively (Nonaka and Takeuchi, 1995; Nonaka, 1988). The structure required to face the knowledge-based economy usually relies on ad-hoc or organic models (Mintzberg, 1979), stressing horizontal links and work teams (James, 2003). This idea has led various authors to suggest new organizational forms such as the hypertext model (Nonaka and Takeuchi, 1995), the N-form (Hedlund, 1994), the federated structures (Handy, 1992), or the J-form (Lam, 2000). Although each one of these forms presents its own peculiarities, they all have something in common: they are hybrid forms (Baskerville and Dulipovici, 2006; Mandeville, 2005; Wang and Ahmed, 2003; Lei et al., 1999). With the expression hybrid forms, these authors mean that these organizational forms try to reconcile the basic formal characteristics of traditional structures, such as functional or divisional forms (Mintzberg, 1979), with other characteristics that are closer to adhocratic, flexible structures. Thus, for instance, the hypertext organization is a combination of a formal organizational structure and a non-hierarchical, self-organizing one. The J-form organization combines the stability and efficiency of a bureaucracy with the flexibility and team dynamics of adhocracy. A similar effect can derive from keeping the formal hierarchical structure and adding the dimension of flexibility to it (Gold et al., 2001).

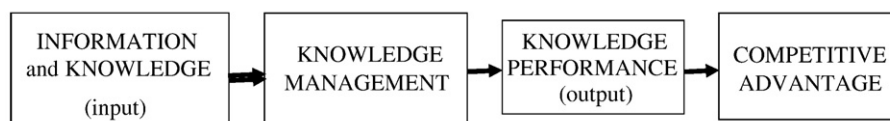


Fig. 1. Causality chain of knowledge-based competitive advantage. Source: adapted from Grant (1991), Helleloid and Simonin (1994) and Nonaka and Takeuchi (1995).

Organizations consequently contain static and dynamic elements that determine the degree to which they create and use knowledge within organizational settings (Beesley, 2004). For this reason, the present paper performs a disaggregated analysis of the main organizational structure dimensions (formalization, complexity, and centralization) with the aim of examining the extent to which they influence knowledge performance. These dimensions of organizational structure have their origin in the theory of organizational design (Burton and Obel, 2005; Robbins, 1990) and, more specifically, in the contingency theory (Donaldson, 2001; Mintzberg, 1979).

### 2.3. Formalization

The term formalization refers to the degree to which formal rules, standard policies, and procedures govern decisions and working relationships (Fredrickson, 1986). Some authors consider that rules restrict the creation of knowledge (Von Krogh, 1998) because they limit the chances for organization members to communicate and interact with one another (López et al., 2006); and the range of new ideas seems to suffer a restriction when strict formal rules dominate an organization (Lee and Choi, 2003). These authors argue that increased flexibility and informal behavior within an organizational structure can result in an increased creation of knowledge (Wang and Ahmed, 2003).

Other studies see formalization as a source for the creation and use of knowledge (Kern, 2006). For instance, formalization and organizational routines are two concepts which present certain similarities (Feldman and Pentland, 2003), as both of them refer to procedures and patterns of behavior, action, or interaction. However, they differ in a very significant way: routines are a form of tacit knowledge while formalization is explicit and codified (Reynaud, 2005). As with formalization, routines can be the antithesis of flexibility because they can drive organizations to inflexible, unchanging patterns of action. Nevertheless, some theorists argue that organizational routines are dynamic systems, rather than static objects (Becker et al., 2005; Feldman and Pentland, 2003), and can consequently foster knowledge creation. The implicit or tacit knowledge base of organizational routines (Cepeda and Vera, 2007), along with the firm's absorptive capacity (Zahra and George, 2002; Cohen and Levinthal, 1990), experimentation and learning by doing (Nonaka and Takeuchi, 1995), will facilitate new knowledge generation through 'double-loop learning' (Argyris and Schön, 1978). This double-loop learning will take place because the involvement of multiple individuals in the development of an organizational routine will result in diversity about knowledge, interpretive schemes, and participants' goals, and individuals will be able to interpret the information and knowledge differently depending on their previous knowledge base, experience, position, and point of view (absorptive capacity, Zahra and George, 2002; Cohen and Levinthal, 1990). The subjective interpretations about the appropriate course of action will differ depending on these factors, and individuals will make appropriate modifications and will create and use new knowledge at the same time (Nonaka and Takeuchi, 1995).

The previous arguments supporting the dynamic conception of routines can equally be valid for the formalization of organizational structure, because, as said above, both routines and formalization relate to procedures established within the organization. Rules tend to be abstract and may guide the different courses of action needed to accomplish an objective in diverse situations (Feldman and Pentland, 2003). Rules are useful for finding a solution to a problem or reaching an objective, but do not provide any detail about that solution. Therefore, each individual may interpret the established rules and procedures differently, depending on their previous knowledge and experience, which leads to the generation of new knowledge.

The preceding argument might lead to the conclusion that individuals would create more knowledge without rules. However, without a formalized structure, the attempts by the members of an

organization to integrate and use new knowledge will probably remain disorganized, infrequent, sporadic or ineffective (Okhuysen and Eisenhardt, 2002). There is an example in the paper by Forrester (2000), according to whom a Japanese automotive firm that used formal organizational procedures to support and promote innovation had succeeded in collecting and disseminating the new ideas about products or services across the whole organization. In contrast, another U.S. automotive firm, more informal and ad-hoc, did meet some internal resistance in the implementation of the new knowledge.

Therefore, formalization not only can benefit the generation of knowledge, but also its use and application in order to improve knowledge performance, for several reasons. Firstly, formalization improves cooperation and collaboration among the organizational staff as a whole (Cordón-Pozo et al., 2006) because it can shape the structure and scope of interactions and provide insights that will prove helpful for knowledge development (Kern, 2006). Secondly, formalization facilitates interfunctional transfer of explicit and codified knowledge by means of rules (Cordón-Pozo et al., 2006) that permit to ease the circulation of the knowledge produced between different parts of the organization, nurturing them with new ideas and different viewpoints (Cohendet et al., 2004). Thirdly, formalization reduces ambiguity (Cordón-Pozo et al., 2006). Rules and procedures are likely to increase the integration of knowledge into organizational units by providing specific behavioral directives for members to follow (thus reducing ambiguity), so that the firm can introduce and use knowledge more effectively in order to enhance knowledge performance. Formalization uses formal procedures that allow employees to deal more effectively with contingencies because they include the best practices learnt from experience and incorporated into the organizational memory (Adler and Borys, 1996). In this case, formalization codifies best practices so as to stabilize and disseminate new knowledge enabling employees to acquire it and use it, and consequently increasing knowledge performance.

One can find an example of the positive association existing between formalization and knowledge performance in the literature about Total Quality Management (TQM). TQM implies the analysis and evaluation of all the activities developed within the firm. That evaluation may generate new knowledge bound to codify in a series of formal documents that lead to improve the quality. As Meirovich, Brender-Ilan, and Meirovich (2007) and Beckmann, Otto, Schaarschuch, and Schrödter (2007) show, formalization correlates positively with the quality of the products or services that the firm offers, which is part of its knowledge performance, as explained above.

Achieving an effective management of knowledge not only requires creating new knowledge but also, more importantly, to have the ability to apply it for the purpose of improving the firm's knowledge performance. In this respect, formalization constitutes a dimension that can facilitate the creation of knowledge, its dissemination and its implementation in processes, products or services, always seeking to improve the firm's competitive position. This reasoning suggest that formalization can influence knowledge performance positively, which is the basis for Hypothesis 1.

**H1.** High levels of formalization have a positive association with knowledge performance.

### 2.4. Complexity

According to Robbins (1990) and Fredrickson (1986), complexity refers to the degree of differentiation that exists within an organization. The three dimensions that usually indicate the level of structural complexity are horizontal, vertical, and spatial differentiation. Vertical differentiation refers to the number of hierarchical levels in the organization; spatial differentiation is the degree to which the location of an organization's offices, plants, and personnel is dispersed geographically; and horizontal differentiation has to do with the



degree of differentiation between —generally interrelated— units, based on the nature of the tasks performed by members, their education or training. Therefore, the horizontal dimension of complexity may have its origin either in a high degree of division between the roles and functions performed within the enterprise (functional specialization) or in the social specialization achieved by hiring professionals who hold not-easily-routinized skills, according to their knowledge, education, and background (Robbins, 1990).

The study reported herein focuses on the horizontal dimension of complexity, which some studies consider a better predictor of knowledge creation than the vertical and spatial dimensions (Damanpour and Schneider, 2006; Damanpour, 1996). This is due to the fact that, regardless of the number of hierarchical levels or geographical locations existing within the firm, horizontal differentiation entails grouping together individuals who share a common knowledge base (homogeneity of knowledge) for the development of joint projects (the different medical specialties in a hospital is an example). Thus, greater horizontal differentiation is likely to improve the skills and abilities of the staff in the activities they perform, because they are specialized in those activities, and it fosters the invention of new methods, technologies, or products related to them (Mintzberg, 1979). The horizontal dimension of complexity could also prove efficient for knowledge application, since absorbing new ideas requires a base of prior knowledge (Nielsen, 2005; Norman, 2004; Postrel, 2002; Cohen and Levinthal, 1990), and the mutual understanding and homogenization of a body of knowledge among employees can facilitate its exploitation (Kogut and Zander, 1996) or application, thus helping to improve the firm's knowledge performance.

Along the same lines, organizational complexity promotes the formulation of proposals for the generation and implementation of new knowledge for several reasons (Aiken et al., 1980). First, high levels of complexity indicate diverse expertise bases (heterogeneity of knowledge) that may result in the identification of a wide range of problems and the availability of diverse kinds of information and knowledge about problem-solving. Second, complexity implies a variety of interests, which may stimulate new proposals as the various occupational groups, departments and strata seek to improve or protect their position in the firm. Third, structural complexity makes possible, and may often require, a formal or informal assignment of special responsibilities to propose organizational changes in particular roles and subunits. Organizational complexity can consequently provide the heterogeneity required to generate knowledge while, at the same time, the internal homogeneity within the departments and units will facilitate its implementation (Forrester, 2000) in order to improve knowledge performance.

On the other hand, Nahapiet and Ghoshal (1998) suggest that social capital or social interaction (Zahra and George, 2002), which refer to the benefits that the socialization or interrelation of its members bring to the firm, also influence the generation of knowledge. The idea of social interaction comes into the concept of complexity used in this study through the role that middle managers play. Knowledge creation benefits from firm members' interaction, which in turn leads to the generation of social capital. Of the three dimensions of social capital that Nahapiet and Ghoshal (1998) describe, namely structural, relational, and cognitive, it is the first one that seems to have a stronger connection with the present study, as it is the one which results from structural configuration and diversity. In this respect, middle managers perform a relevant role when it comes to increasing social capital in its structural dimension by absorbing and facilitating vertical and horizontal flows of information and knowledge inside the company. They become the link between the visionary ideals of the top management and the market-based reality of subordinates (Nonaka, 1988). As the degree of horizontal differentiation increases, a greater number of organizational units and members of middle management may have access to a wider range of information and knowledge. The depth and diversity of the knowledge base may stimulate creativity and increase awareness and the cross-

fertilization of ideas, thus facilitating the generation of new knowledge that the firm can incorporate into the different products and services offered (Damanpour and Schneider, 2006; Seshadri and Shapira, 2003; Aiken et al., 1980). Due to the position they occupy, these middle managers can place more emphasis on the application of knowledge with a view to increase knowledge performance. Therefore, increasing the interactions of agents in the activities of a firm (for example, through inter-departmental encounters and/or meetings) may lead to the development of common knowledge, social capital, and a collective identity that in turn will create a favorable context to improve knowledge performance (Nahapiet and Ghoshal, 1998; Kogut and Zander, 1996). This context relates to what Nonaka and Konno (1998) and Nonaka, Toyama, and Konno (2000) call 'Ba', that is, a shared context or space for the creation, sharing, and use of knowledge.

In short, greater complexity is likely to promote the creation of internal organizational contexts fostering knowledge performance, through the interactions and encounters that middle managers promote. Considering the above, one can expect complexity to have a positive association with knowledge performance, as the following hypothesis (H2) states:

**H2.** High levels of complexity have a positive association with knowledge performance.

## 2.5. Centralization

A low degree of centralization of the decision-making process can complement and enhance the knowledge performance that may result from formalization and complexity. Centralization refers to the degree to which the right to make decisions and evaluate activities is concentrated; while decentralization of decision-making is a consequence of the distribution of authority among the different structural components (Fredrickson, 1986). Decentralization fosters the incorporation of a greater number of individuals and organizational levels into the process of strategic reflection (Robbins, 1990; Hall and Saias, 1980). In this way, decentralization toward the lower levels in the organization can contribute to knowledge creation, because the more individuals become involved in the decision-making process, the more variety and number of ideas will arise and the more likely these ideas will be to materialize in an improved knowledge performance (Ouchi, 2006).

This structural variable has to do with Nonaka's (1994, 1988) concept of autonomy, put forward in his well-known model of knowledge creation (SECI). Nonaka states that when the firm allows individuals to act autonomously, the organization can achieve better business opportunities in relation to new products or services and become more flexible when acquiring and interpreting knowledge. Freedom of action will encourage employees to create and apply new knowledge. Autonomy increases the chances of finding valuable information and encourages organization members to create new knowledge (Nonaka et al., 2000).

Centralization may cause a reduction in the production of creative solutions and hinder interdepartmental communication as well as the frequent circulation and sharing of ideas (Souitaris, 2001) due to the existence of time-consuming formal communication channels. Similarly, Drucker (1992) considers that a firm needs a low degree of centralization for rapid decision-making, which would permit constant change and continuous generation of knowledge. Decentralization would facilitate spontaneity, experimentation, freedom of speech, and the circulation of ideas, which represent the lifeblood of knowledge creation because they increase the organizational members' level of involvement (Lee and Choi, 2003). In decentralized organizations, individuals are exposed to a greater number of opinions and amounts of information, which may lead to a creative integration of perspectives. In contrast, high levels of centralization tend to hinder the development and implementation of new ideas (Bucic and Gudergan, 2004; Amason et al., 1995), since the organization members may show a lower degree

of involvement and motivation to put into practice certain decisions that top management adopts. Lack of participation in the decision-making process is bound to make the understanding of the decisions adopted more difficult, which in turn may mean that the knowledge created elsewhere within the organization will not ultimately lead to an effective improvement of knowledge performance (Hall and Saias, 1980).

Decentralized organizations emphasize the importance of empowerment and facilitate the assimilation of new attitudes and behaviors. A decentralized organizational structure clearly seems to favor an environment where employees participate in knowledge building processes more spontaneously (Lee and Choi, 2003). Low levels of centralization are more likely to encourage creativity (Bucic and Gudergan, 2004; Leenders et al., 2003) and participative work environments foster knowledge creation by motivating organizational members' involvement (Liao, 2007). Therefore, decreased centralization can lead to higher knowledge creation and use levels (Lee and Choi, 2003; Teece, 2000) that will help improve the firm's competitive position.

The decision-making process itself is knowledge-intensive (Holsapple and Joshi, 2001). Decision-makers must manage and exploit the existing knowledge, both their own knowledge and that of the organization, and can simultaneously create new knowledge while solving or recognizing problems that occur during a decision-making process. The decentralization of decision-making requires a greater degree of involvement of members in these processes, which will probably favor the creation of new knowledge and its application to products or services, thus promoting knowledge performance.

In accordance with the above, implementing non-bureaucratic decision-making systems, decreasing centralization of the decision-making process, and allowing as much autonomy as possible may help improve knowledge performance to a significant extent. Therefore, centralization will have an adverse effect, as Hypothesis 3 suggests:

**H3.** High levels of centralization have a negative association with knowledge performance.

Fig. 2 shows the relationships established in the hypotheses proposed.

### 3. Methods

#### 3.1. Sample and data collection

The study reported herein uses a sample of 164 non-diversified Spanish firms with 250 or more workers. The literature generally assumes that implementing knowledge management procedures tends to be easier in smaller firms, because such firms often have a more organic, flexible structure (Lei et al., 1999). Instead, larger firms often run the risk of becoming more rigid and bureaucratic, and less prone to change. Larger organizations are not the most innovative

sources of activity with respect to knowledge management, although they enjoy the advantage of having a potentially broader profile of knowledge issues (Gold et al., 2001). The study concentrates on non-diversified firms so as to avoid significant structural differences across divisions and it chooses Spanish firms because they are increasingly coming to recognize the benefits that the knowledge management process can bring in terms of competitive advantage. Finally, the sample includes companies from various sectors, and not exclusively knowledge-intensive ones, because any organization has the potential to achieve a high level of knowledge performance.

A total population of 1903 firms resulted from a search through several directories of firms. Data was collected by sending a mail survey to each company's Chief Executive Officer (CEO), the person who usually has the widest and deepest understanding of the whole organization. Therefore, they are considered the more appropriate respondent in order to describe the structural elements of the organization in addition to its knowledge performance. The use of single key organizational informants is an effective approach in many research contexts (Liao, 2007; Lee et al., 2005; Norman, 2004; Gold et al., 2001). Following the recommendations of Podsakoff, MacKenzie, Lee, and Podsakoff (2003), a number of measures were adopted to reduce as much as possible the potential risk of common method biases due to a single respondent. Firstly, interviewees remained anonymous and were assured that there were no good or bad answers, asking them to be as sincere and honest as possible. This approach had as its aim to reduce their fear of being evaluated and to stop them from giving socially desirable or appropriate answers. Secondly, the construction of the items was very careful trying to avoid any potential ambiguities. For this purpose, the questionnaire included simple and concise questions as well as definitions of those terms with which interviewees might be less familiar in order to facilitate their understanding.

The preparation of the questionnaire for the survey involved several stages. First, previous studies devoted to organizational structure and knowledge performance issues were the object of a thorough review. Second, content validity was ensured by discussing and reflecting upon the preliminary draft with some experts on the study matter. Third, a pilot test was conducted, in which personal interviews were held with the CEOs of five firms. Once this stage was completed, the final questionnaire was sent. One month after the initial mailing, a follow-up mailing was sent in an attempt to increase the response rate (Dillman, 2000). In the end, 164 firms responded and participated in the study.

Due to the fact that it was not possible to obtain information about all the organizations included in the study population, it is necessary to check the representativeness of the sample, as well as the non-response bias, using variables with known values for the population, such as activity sector and number of employees (Armstrong and Overton, 1977).  $\chi^2$  and  $t$  difference tests reveals no significant differences between respondents and non-respondents. Additionally, regarding unknown variables for the population (knowledge performance, organizational structure and environmental dynamism variables), since firms responding later are theoretically more similar to non-responding firms (Armstrong and Overton, 1977), early respondents (first-wave) are compared with late respondents (second-wave). In all variables,  $t$ -tests show no significant differences between these two groups of firms.

#### 3.2. Measures

##### 3.2.1. Dependent variable

The dependent variable is knowledge performance. Observable outcomes can help measure non-observable variables such as knowledge performance (Baskerville and Dulipovici, 2006; Godfrey and Hill, 1995). This study estimates the dependent variable from six items that combine and adapt the measures and ideas provided in the studies of Ahn et al. (2006), Popadiuk and Choo (2006), Un and Cuervo-Cazurra (2004), Power and Waddell (2004), Nonaka and Takeuchi (1995) and

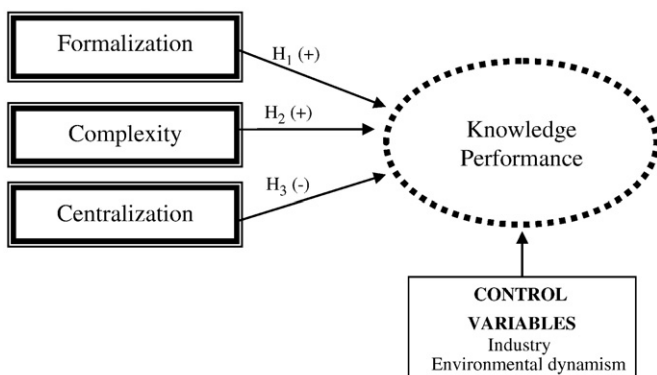


Fig. 2. Model with hypotheses.

Nonaka (1988). Those six items, measured using a seven-point Likert scale, relate to the frequency with which ideas about new products, services and productive processes are generated, and to the extent to which the new knowledge created inside the firm allows the latter to offer complementary amenities, products, or services with higher-quality features or immediate responses to customer requests, all of which makes it possible to achieve a competitive advantage.

### 3.2.2. Independent variables

Regarding the dimensions of organizational structure (formalization, complexity, and centralization), the study takes as its reference the contributions of Wang and Ahmed (2003), Lee and Choi (2003), Nonaka (1988), Miller and Dröge (1986), Aiken et al. (1980). Formalization is estimated from five items measured using a seven-point scale. The items relate to the existence within the firm of rules and regulations that describe working procedures, internal processes, employees' behaviors before certain situations, jobs, and the level of control that the firm exerts in order to ensure compliance. The study estimates complexity from four items, which refer to the degree of specialization, the number of organizational units, the degree of inter-department division, and the extent to which middle managers are encouraged to hold inter-departmental encounters and/or meetings with the aim of facilitating flows of information and knowledge between units. In order to estimate specialization, a list of sixteen functions and activities commonly developed in any type of organization was compiled. For each of the functions and activities, interviewees had to indicate whether their firm had employees who specialized in them, responding 'yes' or 'no'. Specialization is rated from 0 to 16 and then transformed into a seven-point scale, the same as for the other complexity items. Centralization is estimated by including in the questionnaire a total of 11 decisions that an organization must often make. The interviewees had to identify the hierarchical level at which each of these decisions is made, for which purpose the questionnaire offered them a seven-point scale where each value represented a different hierarchical level. This seven-point scale ranged from 1 (for base-level workers, meaning low centralization) to 7 (for the owners, meaning high centralization).

### 3.2.3. Control variables

Since the study object is a multisectorial sample of firms, control over the potential effect of any particular industry is provided by incorporating industry and environmental dynamism variables into the analyses (Schulze and Hoegl, 2006; David et al., 2002; Slater and Olson, 2000). The sample includes six firms in oil and energy, 47 in basic materials, industry and construction, 28 in consumer goods, 67 in consumer services, three in financial services, and 13 in technology and telecommunications. Each industry is introduced into the analysis as a dummy variable. According to Van Den Bosch, Volberda, and De Boer (1999), firms operating in dynamic environments attach greater importance to knowledge. Two dimensions are considered in an attempt to estimate the degree of dynamism existing in the market: (i) the dynamism caused by the rapidity of changes that take place in the business environment, estimated from eight items about technological changes in processes, products, distribution and supplier activities; and (ii) the dynamism linked with the new business opportunities that result from the appearance of new customers and geographical markets or the presence of fewer competitors (four items). A seven-point scale was used in both cases. The studies of Lee and Miller (1996) and Miller and Dröge (1986) were the essential basis to prepare these measurement scales.

Table 1 shows the construct measures.

### 3.2.4. Reliability and validity

Cronbach's alpha coefficient allows to examine the reliability of each one of the previously described scales. This coefficient shows adequate values (see diagonal in Table 2). Content validity and

construct validity are addressed. A review of the literature devoted to the items included in the questionnaire served to ensure content validity. With respect to measuring knowledge performance, for which no established relevant scales are available, this study develops specific items that take advantage of the theoretical contributions on knowledge management (Gold et al., 2001) or derived from in-depth discussions with academics and CEOs during the pre-testing phase of questionnaire development. The study uses three approaches to examine construct validity: convergent, divergent, and nomological validity. Convergent validity is assessed by examining the correlation of a particular item with the latent construct to which the item belongs (Lee and Choi, 2003). Significant positive correlations appear. Divergent validity is examined through detailed analysis of all the items, which reveals that the items included in each construct generally correlate positively and significantly with one another, but not with the items that belong to the other constructs. Nomological validity, which involves determining the degree to which a construct relates to other constructs in a manner predicted by theory, is studied by analyzing the correlations between constructs (see Table 2). All analyses provide reasonable evidence that the measures used are reliable and valid.

Due to the fact that this study identifies a new measurement scale for knowledge performance, a confirmatory factor analysis is conducted to achieve support for the level of validity and reliability of this measure. LISREL 8.5, which evaluates concept reliability, convergent validity and unidimensionality, served to perform this analysis. To assess scale reliability, the study computes the composite reliability estimates (Fornell and Larcker, 1981) which has a value of 0.753. This value is greater than the minimum recommended level of 0.7 (Bagozzi and Yi, 1988). The significance of the factor loadings serves to examine convergent validity. All the loadings of the measurement items on the hypothesised construct are significant ( $p < 0.05$ ) providing evidence of convergent validity (Anderson and Gerbing, 1988). Two sets of statistics are used to assess unidimensionality: (a) the significance of the factor loadings, that is, the estimated correlation between a particular item and the latent construct it represents and (b) the overall acceptability of the measurement model in terms of the model's fit to the data. The results indicate that the scale is unidimensional, representing a single factor (Anderson and Gerbing, 1988). Bollen (1989) recommends examining multiple indices of model fit to assess validity and unidimensionality when using structural equation models, since a model may prove adequate on one fit index but inadequate on many others. The results obtained in the confirmatory factor analysis indicate that exist convergent validity and unidimensionality. The chi-square statistic ( $\chi^2$  Satorra-Bentler = 10.36,  $df = 8$ ) is significant and the fit indices approach the preferred threshold of 0.90 (NFI = 0.954; NNFI = 0.98; AGFI = 0.95; GFI = 0.98). Further, the small magnitude of residuals (RMR = 0.07; RMSEA = 0.04) also indicates appropriate model data fit.

## 4. Results and discussion

The hypotheses are tested using hierarchical regression analysis. Knowledge performance is firstly regressed on industry control variables (Model 1) (taking as a reference the sector considered the most knowledge-intensive one, namely technology and telecommunications). Secondly, the two variables related to environmental dynamism complete the previous model (Model 2). Then, the organizational structure variables are introduced into the regression model (Model 3). There is no problem with multicollinearity, because the variance inflation factor is below 5 in all independent variables (Mason and Perreault, 1991).

Table 3 shows that the  $R^2$  coefficient increases significantly (i) when the regression model includes variables corresponding to environmental dynamism (Model 2); and (ii) when the regression model includes features of the organizational structure (Model 3) in

**Table 1**  
Measures.

Constructs	Items
Knowledge Performance (1=Totally disagree; 7=Totally agree)	High frequency in the generation of ideas about new products High frequency in the generation of ideas about new services High frequency in the generation of ideas about production processes Generated knowledge allows to offer products and services with higher-quality features Generated knowledge facilitates the immediate response to customer requests Generated knowledge allows to offer complementary amenities
Formalization (1=Low degree; 7=High degree)	Regulations on procedures Regulations on the monitoring of work development Monitoring of employees Rules of behavior Resources to ensure compliance with rules
Complexity (1=Very low; 7=Very high)	Degree of inter-department division (number of managers and hierarchical levels) Number of organizational units Specialization*
Centralization (1=Based-level workers; 7=Owners)	Degree of inter-departmental encounters and/or meetings are held Decisions about work conflicts Decisions about overtime Decisions about employee recruitment Decisions about job assignment Decisions about machinery Decisions about worker layoffs Decisions about order priority Decisions about employee numbers Decisions about working methods Decisions about staff selection Decisions about production plans
Dynamism caused by rapidity of changes (1=Very slow; 7=Very fast)	Frequency of changes in production technology Frequency of process innovations Frequency of product innovations Frequency of obsolete products Frequency of provider changes Frequency of changes in marketing activities Frequency of changes in providers' prices Frequency of changes in distribution channels
Dynamism linked with new business opportunities (1=Reduced drastically; 7=Increased greatly)	New potential customers New geographical markets New business possibilities New competitors

\* A list of 16 functions that the organization performs on a regular basis –so that managers could say if there were individuals specialized in each one of them– served to estimate specialization. The sum of the number of specialties was later transformed into a seven-point scale.

comparison with Model 1, which considers dummy industry control variables exclusively.

Regarding organizational design features, the value of the regression coefficient for formalization is non-significant and cannot confirm H1. As for complexity, the regression coefficient is positive and significant, which confirms H2. Finally, the regression coefficient for centralization is negative and significant, thus confirming H3.

The results of the analysis demonstrate that some sectors are more knowledge-intensive than others. The activity sector related to basic materials, industry, and construction has the lowest knowledge performance scores compared to the technology and telecommunications sector (the sector of reference). Nevertheless, once the industry effect is under control, the perception of environmental dynamism by executives (Model 2) and the characteristics of organizational

**Table 2**  
Means, standard deviations, correlations and Cronbach's alpha.

	1	2	3	4	5	6
Mean	4.7	3.7	4.4	3.8	4.1	4.0
s.d.	0.97	0.89	0.91	0.64	0.98	1.39
1. Knowledge performance	0.76					
2. Dynamism of rapid changes	0.44**	0.76				
3. Dynamism of new opportunities	0.20*	0.20*	0.61			
4. Formalization	−0.11	−0.09	0.14	0.77		
5. Complexity	0.17*	0.06	0.03	−0.06	0.63	
6. Centralization	−0.23**	−0.07	0.09	0.13	−0.21**	0.87

\* $p < 0.05$ ; \*\* $p < 0.01$ ; Cronbach's alpha on the diagonal.

structure (Model 3) reduce the differences in knowledge performance between sectors. This finding shows that a knowledge organization is not necessarily a knowledge-intensive one (Baskerville and Dulipovici, 2006).

The positive relationship between environmental dynamism and knowledge performance indicates that firms operating in dynamic environments attach greater importance to knowledge (Van Den Bosch et al., 1999) because they need to supply more competitive products and technologies in rapidly changing markets where

**Table 3**  
Results drawn from the regression analysis of knowledge performance.

Independent variables	Model 1	Model 2	Model 3
Industry 1 (Oil and energy)	−.200**	−.148*	−.175**
Industry 2 (Basic materials, industry and construction)	−.423***	−.193	−.119
Industry 3 (Consumer goods)	−.163	.015	.090
Industry 4 (Consumer services)	−.332**	−.112	−.023
Industry 5 (Financial services)	.084	.061	.037
Dynamism of rapid changes		.403***	.387***
Dynamism of new opportunities		.156**	.178**
Formalization			−.066
Complexity			.159**
Centralization			−.211***
$R^2$	.10	0.26	0.33
Adjusted $R^2$	.07	0.23	0.29
$F$	3.55***	8.00***	7.52***
$\Delta R^2$		0.16***	0.07***

\* $p < 0.10$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$ .



products and technologies become obsolete relatively fast. Faced with this context of dynamism, enterprises seem to have realized that they need a strategy to manage knowledge which can provide and maintain attractive offers of products and services in an ever-changing scenario. Consequently, companies must innovate continuously (Un and Cuervo-Cazurra, 2004). They must acquire and/or generate new knowledge that allows them to become more competitive and proactive in their response to frequent changes in customer preferences, and in the products of competitors too. The continuous innovations and the new product development projects undertaken by firms such as Honda, Canon or Sony, all of which belong to highly dynamic sectors, are good examples about the relationship between environmental dynamism and knowledge performance.

The positive relationship between the dynamism of the environment and knowledge performance might equally have to do with the possibilities for the firm to increase the volume of knowledge acquired externally. Greater dynamism means that the environment experiences rapid changes in new technologies, processes, products, etc., from which the firm could obtain knowledge thanks to its contacts and relationships with other agents present in the business environment, such as customers and suppliers (Hall and Andriani, 2003), or strategic alliances (Nielsen, 2005; Norman, 2004), and later try to apply that knowledge for the purpose of improving the organization's competitive advantage. Hall and Andriani (2003) present a case study about a major mobile telephone operator in which they analyze the participation, both of suppliers and of customers, in the generation of knowledge and its application to innovation. Also the American automobile firm analyzed by Forrester (2000) highlights the use of both internal and external sources of information, in the form of customer feedback or external assistance. Since these works have already examined these links, the present study includes environment dynamism as a control variable with a view to determine the influence on knowledge performance that derives from the firm's internal processes and, more precisely, from the characteristics of the organizational structure.

Regarding organizational structure, H1 posits a positive relationship between formalization and knowledge performance, because each individual may interpret differently the norms and rules that regulate the behavior of employees, thus giving rise to the generation and application of new knowledge through practice and experience (learning by doing, Nonaka and Takeuchi, 1995). The observed relationship is negative, but not statistically significant, which means that H1 can be neither confirmed nor rejected. Lee and Choi (2003) come to the same conclusion regarding the relationship between formalization and knowledge creation, as well as Cordón-Pozo et al. (2006). Neither does the paper by Liao (2007) reveal a clear, significant link between formalization and knowledge management. However, similar studies find a positive relationship (Gupta et al., 1986) while others obtain a negative association when relating flexibility (as opposed to formalization) and learning (López et al., 2006).

The non-significant relationship could actually be underlining the relevance of the two different aspects of formalization highlighted in the theoretical section. On the one hand, formalization enables a clear, accurate definition of tasks, activities, and relationships, thanks to which members of the organization will presumably become more efficient in their performance through the transformation of tacit knowledge into explicit knowledge (Lee and Choi, 2003), the latter being easier to disseminate, use and interpret throughout the organization. Similarly, rules and regulations reduce the potential ambiguity involved in the development of activities (Adler and Borys, 1996), although sometimes individuals interpret the norm according to their previous knowledge, seeking to find a specific solution from which one can generate knowledge (double-loop learning). On the other hand, when something has become institutionalized (or formalized), it tends to last for some time (Crossan et al., 1999), which is why changes in systems, structures, and routines do not often occur in highly institutionalized organizations.

As the environment evolves and demands new knowledge, firms may find difficult to adjust institutionalized knowledge to new situations. A gap may appear between what the organization needs to do and what it has learnt to do (Zack, 1999).

The contradictory literature findings along with the non-significant relationship between formalization and knowledge performance found in the present study suggest the need for a more in-depth analysis, or one performed from other perspectives, in order to determine the impact of formalization on knowledge performance. For instance, a possible in-depth analysis could stem from the fact that because there seem to be aspects of formalization that restrict the creation of knowledge while others favor its efficient use, it would be advisable to perform two separate analyses: one about the existence of norms and rules which enable the firm to exploit the existing knowledge efficiently and the other about the extent to which firms enforce those norms and rules (Adler and Borys, 1996), checking whether or not they permit to maintain the degree of flexibility required to address environmental dynamism effectively (Graham and Pizzo, 1996). Perhaps, this distinction between the existence of rules and their degree of enforcement would bring us to an approach similar to the concept of permissive formalization proposed by Adler and Borys (1996), according to which the firm should not view formalized knowledge as an unchanging instructions manual to follow strictly, but rather as a guide that the firm can permanently enlarge and improve as it gains further knowledge. It would equally be convenient to analyze how the new generated knowledge gradually incorporates into the norms and rules of formalization, checking through a longitudinal analysis how these norms and rules go through a process of adaptation with the passing of time.

Additional analytical perspectives might include the study of some variable with a mediating or moderating role in the relationship between formalization and knowledge performance, as this relationship may not be direct. In this respect, the existence of some rules and regulations that collect knowledge may become a necessary condition to capture the best practices and learnt experiences, but not a sufficient condition for individuals to express a predisposition to share knowledge with one another (Un and Cuervo-Cazurra, 2004). This predisposition to share knowledge could be a mediating or moderating variable for the model proposed in this paper. In relation to this argument, the study of Ibrahim and Nissen (2007) offers an example of a firm in the domain of facility development where, though explicit knowledge is documented, such knowledge does not flow through the organization because individuals are not motivated to share it. Consequently, there is a lower likelihood of that knowledge eventually having a significant effect on new products or services that can improve the firm's competitiveness, unless additional measures come to complement formalization.

The significant positive relationship found between organizational complexity and knowledge performance (H2) seems to indicate that, in complex organizations, the depth and diversity of the knowledge base may stimulate creativity and increase the willingness to share information and knowledge, as well as the cross-fertilization of ideas (Damanpour, 1996) due to the interaction between individuals (Zahra and George, 2002). In this way, it is possible to create an environment that promotes the generation of new knowledge (Ba) (Nonaka and Konno, 1998) through the role that middle managers play. As stated in the literature review section, the production of ideas may experience an enhancement as the complexity of an organization increases due to the variety of knowledge bases yielded by the specialization of individuals and the different perspectives of departments (Aiken et al., 1980). Moreover, horizontal dimension of complexity can facilitate the absorption of new knowledge (Cohen and Levinthal, 1990) and increase workers' skills at the activities they perform, thus favoring the invention of new methods, technologies, or products (Mintzberg, 1979).

Therefore, organizational complexity is likely to help in identifying a greater number of problems and opportunities for change and



improvement, and simultaneously to provide a wider range of approaches to solve those problems (Aiken et al., 1980) or to implement possible initiatives for improvement (Forrester, 2000). Middle managers play an important role in this context because they act as a bridge or link between various hierarchical levels and different departments, assimilating the flows of information and knowledge, and facilitating their distribution throughout the company (Nonaka, 1988). The frequency with which middle managers communicate and hold meetings between the different parts of the organization will probably improve knowledge performance. There is an example in the paper by Seshadri and Shapira (2003) which reports that a manager of the Sony Corporation brought together the innovation projects of two departments (one which tried to minimize the size of the tape recorder, and another which had as its aim to develop lightweight portable headphones). This initiative led to the invention of the walkman.

The significant negative relationship identified between centralization and knowledge performance (H3) reveals that giving more autonomy to company members in certain decision-making processes benefits knowledge generation; and the implementation of new initiatives becomes easier (Holsapple and Joshi, 2001; Nonaka et al., 2000). As explained above, a low degree of centralization encourages the involvement of a greater number of individuals and organizational levels in the process of strategic reflection. Precisely one of the firms interviewed during the pre-test stage pointed out that a few years ago had initiated a decentralized type of strategic reflection process in which had taken part representatives of the different hierarchical levels within the organization. This process led to the development of some objectives such as customer orientation, internationalization and expansion to all markets, and new product development.

The delegation of responsibilities to lower levels in the organization can contribute to knowledge creation, because empowerment allows individuals to act autonomously, thus maintaining a certain degree of flexibility in the acquisition and interpretation of knowledge (Lee and Choi, 2003). This autonomy provides individuals with a stronger motivation to experiment (Liao, 2007) and carry out proposals that result in the creation of new knowledge.

It follows from the above that organizational complexity and low levels of centralization can become complementary variables in the improvement of knowledge performance, because the former may provide a suitable context for interaction and communication among firm members (Nonaka and Konno, 1998), as well as the knowledge base required for its absorption (Nielsen, 2005; Postrel, 2002; Zahra and George, 2002; Cohen and Levinthal, 1990), whereas the latter provides greater autonomy and a delegation of responsibilities at several organizational levels, thus promoting not only the generation of new knowledge but also its application (Lee and Choi, 2003).

An example of complementariness between complexity and low levels of centralization appears again in the study by Ibrahim and Nissen (2007) about a facility development project. In this case, the firm decentralized the decision-making process toward low-level members. However, the failure of communications between the project manager and the civil engineer during the Civil Survey task eventually led to the failure of the septic tank design for the housing project. Unless managers inform the members of the different departments about the critical situation that will impact on their jobs, there is a high likelihood of other team or department members simply proceeding as originally planned.

According to Lam (2000), professional bureaucracy is also an organizational form with a high level of complexity and decentralization where individual experts have a high degree of autonomy and discretion for the application and acquisition of knowledge within their own specialist areas. In the light of the results obtained in the present study, the role of middle managers could serve to increase the level of interaction between different specialists as well as the sharing of knowledge with non-experts. As one of the companies interviewed in the pilot test pointed out, increasingly complex organization and decentralization favor the active participation of the whole firm, the

combination of top-down and down-top management methodologies being essential. Middle managers arise as a key element in the communication process according to this approach.

Summing up, although there is not a clear consensus, a number of researchers argue that the traditional organizational forms, characterized by a strict division of labor, hierarchical control and centralization, are seldom very effective at shaping organizations that promote learning and knowledge creation (Hedlund, 1994). However, traditional forms should not be abandoned because, as the above results show, the traditional characteristics of organizational structure still play a relevant role in the knowledge-based economy.

## 5. Conclusions

Organizational structure is a critical aspect of knowledge management, because a good structure can coordinate all the elements within the organization and encourage the generation, transfer, and application of new knowledge. The present paper analyzes how the traditional variables defining organizational structure (formalization, complexity, and centralization) influence knowledge performance. The results confirm that decentralizing and increasing the complexity of organizational structure have a positive, significant influence on knowledge performance. In the case of formalization, no significant relationship with the dependent variable appeared.

The present study makes both theoretical and practical contributions. The theoretical contributions are threefold. Firstly, the study links the traditional theory of organizational design to the theory of knowledge connecting the classical characteristics of organizational structure to more dynamic concepts from the study of knowledge management. Although the literature often assumes the existence of links between organizational structure and knowledge, much of the previous research on knowledge management relies on case studies or other non-quantitative descriptive methods (Ellinger and Bostrom, 2002; Von Krogh, 1998; Bierly and Chakrabarti, 1996; Graham and Pizzo, 1996). This study fills this gap in the literature by providing empirical evidence on how firms may tailor organizational structure to facilitate and promote knowledge performance. More specifically, the results show that some of the most traditional dimensions of organizational design are still valid, for example, organizational complexity and decentralization. Secondly, the paper tests the theoretical assumptions across a broad range of industries. Thus, the generalization of the results not only applies to a particular sector or to knowledge-intensive firms. Thirdly, the study approaches the measurement of knowledge performance in an innovative way, by creating and validating a measuring scale that is likely to prove useful in future research on knowledge management. This is in contrast to other studies, some of which use measures such as knowledge satisfaction (Becerra-Fernandez and Sabherwal, 2001), while others adopt conventional performance measures such as ROA (Bierly and Chakrabarti, 1996) or organizational effectiveness (Gold et al., 2001).

With respect to the practical contributions made, one can highlight the idea that the management is facing new patterns and combinations of old variables. One of the main challenges is to understand the role of knowledge as a strategic intangible resource. Once managers recognize the value of knowledge, they must take a leading role in the promotion of knowledge performance, as explained in the preceding section. They need to build an internally consistent organization design that favors knowledge performance. In that way, they will empower employees to proactively participate in organizational management through the decentralization of the decision-making process and will additionally promote organizational complexity for the purpose of creating a work context where everybody can make use of their specialization and, at the same time, benefit from that of their colleagues as a result of the interaction between the different departments and hierarchical levels. Moreover, middle managers, who provide one of the key integrating mechanisms, are also responsible for gaining a good level of

knowledge performance. They should foster the transfer of new knowledge among all firm members through interdepartmental encounters and/or meetings.

The present study also has some limitations. Firstly, the sample of 164 firms constitutes only a small percentage of the population under study, although the analysis of the non-response bias revealed that the sample is representative. Secondly, the data are cross-sectional rather than longitudinal, which is why the associations between variables do not suffice to establish causality relationships. Both the results and the limitations of the study point to further research in this field: carrying out longitudinal analyses, extending the analysis to small and medium-sized enterprises, and trying to identify other variables that can exert an influence on the proposed model, for instance, in the relationship between formalization and knowledge performance. It would equally be of interest to analyze how knowledge performance can influence firm performance.

## References

- Adler PS, Borys B. Two types of bureaucracy: enabling and coercive. *Adm Sci Q* 1996;41(1): 61–89.
- Ahn JH, Lee DJ, Lee SY. Balancing business performance and knowledge performance of new product development. *Long Range Plann* 2006;39(5):525–42.
- Aiken M, Bacharach S, French JL. Organizational structure, work process, and proposal making in administrative bureaucracies. *Acad Manage J* 1980;23(4):631–52.
- Amason AC, Thompson KT, Hochwarter WA, Harrison AW. Conflict: an important dimension in successful management teams. *Organ Dyn* 1995;24(2):20–34.
- Anderson JC, Gerbing DW. Structural equation modeling in practice: a review and recommended two-step approach. *Psychol Bull* 1988;103(3):411–23.
- Argyris C, Schön D. Organizational learning. MA: Addison-Wesley; 1978.
- Armstrong JS, Overton TS. Estimating nonresponse bias in mail surveys. *J Mark Res* 1977;14(3):396–402.
- Barney J. Firm resources and sustained competitive advantage. *J Manage* 1991;17(1): 99–120.
- Bagozzi RP, Yi Y. On the evaluation of structural equation models. *J Acad Mark Sci* 1988;16(1):74–94.
- Baskerville R, Dulipovici A. The theoretical foundations of knowledge management. *Knowl Manag Res Pract* 2006;4(2):83–105.
- Becerra-Fernandez I, Sabherwal R. Organizational knowledge management: a contingency perspective. *J Manag Inf Syst* 2001;18(1):23–55.
- Becker M, Lazaric N, Nelson R, Winter S. Applying organizational routines in understanding organizational change. *Ind Organ Change* 2005;14(5):775–91.
- Beckmann C, Otto HU, Shaarschuch A, Shródtter M. Quality management and formalization in social service organizations. A survey on home-based family intervention services. *Soc Work Soc* 2007;5(1):78–93.
- Beesley L. Multi-level complexity in the management of knowledge networks. *J Knowl Manag* 2004;8(3):71–88.
- Bhagat R, Kedia B, Harveston P, Triandis H. Cultural variations in the cross-border transfer of organizational knowledge: an integrative framework. *Acad Manage Rev* 2002;27(2):204–21.
- Bierly P, Chakrabarti A. Generic knowledge strategies in the USA pharmaceutical industry. *Strateg Manage J* 1996;17:123–35 (Winter special issue).
- Bollen KA. Structural equations with latent variables. New York: John Wiley & Sons; 1989.
- Bucic T, Gudergan SP. The impact of organizational settings on creativity and learning in alliances. *Management* 2004;7(3):257–73.
- Burton RM, Obel B. Strategic organizational diagnosis and design. The Dynamics of Fit. (3rd ed.). New York: Springer; 2005.
- Cepeda G, Vera D. Dynamic capabilities and operational capabilities: a knowledge management perspective. *J Bus Res* 2007;60(5):426–37.
- Cohen W, Levinthal D. Absorptive capacity: a new perspective on learning and innovation. *Adm Sci Q* 1990;35(1):128–52.
- Cohendet P, Creplet F, Diani M, Dupouët O, Schenk E. Matching communities and hierarchies within the firm. *J Manage Gov* 2004;8(1):27–48.
- Cordón-Pozo E, García-Morales VJ, Aragón-Correa JA. Inter-departmental collaboration and new product development success: a study on the collaboration between marketing and R&D in Spanish high-technology firms. *Int J Technol Manag* 2006;35(1/2/3/4): 52–79.
- Crossan MM, Lane HW, White RE. An organizational learning framework: from intuition to institution. *Acad Manage Rev* 1999;24(3):522–37.
- Damanpour F. Organizational complexity and innovation: developing and testing multiple contingency models. *Manage Sci* 1996;42(5):693–716.
- Damanpour F, Schneider M. Phases of the adoption of innovation in organizations: effects of environment, organization and top managers. *Br J Manag* 2006;17(3):215–36.
- Davenport T, De Long D, Beers M. Successful knowledge management projects. *Sloan Manage Rev* 1998;39(2):43–57.
- David JS, Hwang Y, Pei BK, Reneau JH. The performance effects of congruence between product competitive strategies and purchasing management design. *Manage Sci* 2002;48(7):866–85.
- Dillman DA. Mail and internet surveys. The Tailored Design Method. 2nd ed. New York: John Wiley; 2000.
- Donaldson L. The contingency theory of organizations. Thousand Oaks, CA: Sage Publications; 2001.
- Drucker P. The new society of organizations. *Harv Bus Rev* 1992;70(5):95–104.
- Drucker P. Post-capitalist society. New York: HarperCollins; 1993.
- Eisenhardt KM, Santos FM. Knowledge-based view: a new theory of strategy? In: Pettigrew A, Thomas H, Whittington R, editors. Handbook of Strategy and Management. London: Sage Publications; 2001. p. 139–64.
- Ellinger AD, Bostrom RP. An examination of managers' beliefs about their roles as facilitators of learning. *Manag Learn* 2002;33(2):147–79.
- Feldman M, Pentland B. Reconceptualizing organizational routines as a source of flexibility and change. *Adm Sci Q* 2003;48(1):94–118.
- Fornell C, Larcker DF. Evaluating structural equation models with unobservable variables and measurement error. *J Mark Res* 1981;18(1):39–50.
- Forrester RH. Capturing learning and applying knowledge: an investigation of the use of innovation teams in Japanese and American automotive firms. *J Bus Res* 2000;47(1): 35–45.
- Fredrickson JW. The strategic decision process and organizational structure. *Acad Manage Rev* 1986;11(2):280–97.
- Godfrey PC, Hill CWL. The problem of unobservables in strategic management research. *Strateg Manage J* 1995;16(7):519–33.
- Gold A, Malhotra A, Segars A. Knowledge management: an organizational capabilities perspective. *J Manag Inf Syst* 2001;18(1):185–214.
- Graham AB, Pizzo VG. A question of balance: case studies in strategic knowledge management. *Eur Manag J* 1996;14(4):338–46.
- Grant R. The resource-based theory of competitive advantage: implications for strategy formulation. *Calif Manage Rev* 1991;33(3):114–35.
- Grant R. Toward a knowledge-based theory of the firm. *Strateg Manage J* 1996;17: 109–22 (Winter special issue).
- Gupta A, Govindarajan V. Knowledge flows within multinational corporations. *Strateg Manage J* 2000;21(4):473–96.
- Gupta A, Raj SP, Wilemon D. A model for studying R&D-marketing interface in the product innovation process. *J Mark* 1986;50(2):7–17.
- Hall DJ, Saias MA. Strategy follows structure. *Strateg Manage J* 1980;1(2):149–63.
- Hall R, Andriani P. Managing knowledge associated with innovation. *J Bus Res* 2003;56(2): 145–52.
- Handy C. Balancing corporate power: a new federalist paper. *Harv Bus Rev* 1992;70(6):59–72.
- Hayek FA. The use of knowledge in society. *Am Econ Rev* 1945;35(September):519–30.
- Hedlund G. A model of knowledge management and the N-form corporation. *Strateg Manage J* 1994;15(S2):73–90.
- Helleloid D, Simonin B. Organizational learning and a firm's core competence. In: Hamel G, Heene A, editors. Competence-Based Competition. Chichester: Wiley; 1994. p. 213–39.
- Holsapple CW, Joshi KD. Organizational knowledge resources. *Decis Support Syst* 2001;31(1): 39–54.
- Ibrahim R, Nissen M. Discontinuity in organizations: developing a knowledge-based organizational performance model for discontinuous membership. *Int J Knowl Manag* 2007;3(1):10–28.
- James CR. Designing learning organizations. *Organ Dyn* 2003;32(1):46–61.
- Kern A. Exploring the relation between creativity and rules: the case of the performing arts. *Int Stud Manage Org* 2006;36(1):63–80.
- Kogut B, Zander U. What firms do? Coordination, identity, and learning. *Organ Sci* 1996;7(5):502–18.
- Lam A. Tacit knowledge, organizational learning and societal institutions: an integrated framework. *Organ Stud* 2000;21(3):487–513.
- Lee J, Miller D. Strategy, environment and performance in two technological contexts: contingency theory in Korea. *Organ Stud* 1996;17(5):729–50.
- Lee H, Choi B. Knowledge management enablers, processes, and organizational performance: an integrative view and empirical examination. *J Manag Inf Syst* 2003;20(1):179–228.
- Lee KC, Lee S, Kang W. KMPI: measuring knowledge management performance. *Inf Manage* 2005;42(3):469–82.
- Leenders RTHAJ, Van Engelen JML, Kratzer J. Virtuality, communication, and new product team creativity: a social network perspective. *J Eng Technol Manag* 2003;20(1–2):69–92.
- Lei D, Slocum JW, Pitts RA. Designing organizations for competitive advantage: the power of unlearning and learning. *Organ Dyn* 1999;27(3):24–38.
- Leibenstein H. Allocative efficiency vs. 'X-efficiency'. *Am Econ Rev* 1966;56(3):392–415.
- Liao YS. The effects of knowledge management strategy and organization structure on innovation. *Int J Manage* 2007;24(1):53–60.
- López S, Peón JM, Ordás CJ. The organisational context of learning: an empirical analysis. *Int J Technol Manag* 2006;35(1/2/3/4):196–223.
- Mandeville T. Collaboration and the network form of organization in the new knowledge-based economy. In: Rooney D, Hearn G, Ninan A, editors. Handbook on the Knowledge Economy. Cheltenham: Edward Elgar; 2005.
- Mason C, Perreault Jr WD. Collinearity, power, and interpretation of multiple regression analysis. *J Mark Res* 1991;28(3):268–80.
- Meirovich G, Brender-Ilan Y, Meirovich A. Quality of hospital service: the impact of formalization and decentralization. *Int J Health Care Qual Assur* 2007;20(3):240–52.
- Miller D, Dröge C. Psychological and traditional determinants of structure. *Adm Sci Q* 1986;31(4):539–60.
- Mintzberg H. The structuring of organizations: a synthesis of the research. New Jersey: Prentice-Hall; 1979.
- Nahapiet J, Ghoshal S. Social capital, intellectual capital, and the organizational advantage. *Acad Manage Rev* 1998;23(2):242–67.
- Nielsen BB. The role of knowledge embeddedness in the creation of synergies in strategic alliances. *J Bus Res* 2005;58(9):1194–204.
- Nonaka I. A dynamic theory of organizational knowledge creation. *Organ Sci* 1994;5(1): 14–37.

- Nonaka I. Toward middle-up-down management: accelerating information creation. *MIT Sloan Manag Rev* 1988;29(3):9–18.
- Nonaka I, Takeuchi H. *The knowledge-creating company*. New York: Oxford University Press; 1995.
- Nonaka I, Konno N. The concept of 'Ba': building a foundation for knowledge creation. *Calif Manage Rev* 1998;40(3):40–54.
- Nonaka I, Toyama R, Konno N. SECI, Ba and leadership: a unified model of dynamic knowledge creation. *Long Range Plann* 2000;33(1):5–34.
- Norman P. Knowledge acquisition, knowledge loss, and satisfaction in high technology alliances. *J Bus Res* 2004;57(6):610–9.
- Okhuysen G, Eisenhardt K. Integrating knowledge in groups: how formal interventions enable flexibility. *Organ Sci* 2002;13(4):370–86.
- Ouchi WG. Power to the principals: decentralization in three large school districts. *Organ Sci* 2006;17(2):298–307.
- Peteraf M. The cornerstones of competitive advantage: a resource-based view. *Strateg Manage J* 1993;14(3):179–91.
- Podsakoff PM, MacKenzie SB, Lee JY, Podsakoff NP. Common method biases in behavioral research: a critical review of the literature and recommended remedies. *J Appl Psychol* 2003;88(5):879–903.
- Popadiuk S, Choo CW. Innovation and knowledge creation: how are these concepts related? *Int J Inf Manage* 2006;26(4):302–12.
- Postrel S. Islands of shared knowledge: specialization and mutual understanding in problem-solving teams. *Organ Sci* 2002;13(3):303–20.
- Power J, Waddell D. The link between self-managed work teams and learning organizations using performance indicators. *Learn Organ* 2004;11(2/3):244–59.
- Quintas P, Lefrere P, Jones G. Knowledge management: a strategic agenda. *Long Range Plann* 1997;30(3):385–91.
- Reynaud B. The void at the heart of rules: routines in the context of rule-following. The case of the Paris Metro Workshop. *Ind Corp Change* 2005;14(5):847–71.
- Robbins SP. *Organization theory: structure, design, and applications*. (3rd ed.). New Jersey: Prentice Hall; 1990.
- Schulze A, Hoegl M. Knowledge creation in new product development projects. *J Manage* 2006;32(2):210–36.
- Seshadri S, Shapira Z. The flow of ideas and timing of evaluation as determinants of knowledge creation. *Ind Corp Change* 2003;12(5):1099–124.
- Slater SF, Olson EM. Strategy type and performance: the influence of sales force management. *Strateg Manage J* 2000;21(8):813–29.
- Söderquist KE. Organising knowledge management and dissemination in new product development. Lessons from 12 Global Corporations. *Long Range Plann* 2006;39(5):497–523.
- Souitaris V. Strategic influences of technological innovation in Greece. *Br J Manage* 2001;12(2):131–47.
- Spender JC. Making knowledge the basis of a dynamic theory of the firm. *Strateg Manage J* 1996;17:45–62 (Winter special issue).
- Szulanski G. Exploring internal stickiness: impediments to the transfer of best practice within the firm. *Strateg Manage J* 1996;17:27–43 (Winter special issue).
- Teece DJ. Strategies for managing knowledge assets: the role of firm structure and industrial context. *Long Range Plann* 2000;33(1):35–54.
- Tissen R, Andriessen D, Lekane F. *The knowledge dividend*. Pearson Education Limited; 2000.
- Un CS, Cuervo-Cazurra A. Strategies for knowledge creation in firms. *Br J Manage* 2004;15(S1):S27–41.
- Van Den Bosch F, Volberda HW, De Boer M. Coevolution of firm absorptive capacity and knowledge environment: organizational forms and combinative capabilities. *Organ Sci* 1999;10(5):551–68.
- Von Krogh G, Ichijo K, Nonaka I. *Enabling knowledge creation. How to Unlock the Mystery of Tacit Knowledge and Release the Power of Innovation*. Oxford University Press, Inc; 2000.
- Von Krogh G. Care in knowledge creation. *Calif Manage Rev* 1998;40(3):133–53.
- Wang CL, Ahmed PK. Structure and structural dimensions for knowledge-based organizations. *Meas Bus Excell* 2003;7(1):51–62.
- Wernerfelt B. A resource based view of the firm. *Strateg Manage J* 1984;5(2):171–80.
- Wiig K. Knowledge management: an introduction and perspective. *J Knowl Manag* 1997;1(1):6–14.
- Zack M. Managing codified knowledge. *Sloan Manag Rev* 1999;40(4):45–58.
- Zahra SA, George G. Absorptive capacity: a review, reconceptualization, and extension. *Acad Manage Rev* 2002;27(2):185–203.