OLKC 2009
AMSTERDAM (THE NETHERLANDS)
26-28 APRIL

KNOWLEDGE MANAGEMENT PRACTICES, CULTURE AND TECHNOLOGY: AN EMPIRICAL STUDY

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Abstract

In this paper we analyze the relationships between certain knowledge management (KM) practices, organizational culture and the technological results of companies. In the last few years, KM literature has highlighted the important role of cultural values on the way KM processes are developed and applied in organizations. From this viewpoint, and focusing on a set of knowledge storage and transfer practices, we try to empirically analyse the existence of a multiplier effect of the knowledge-centred organizational culture on the relationship between these kinds of knowledge practices and the technological performance of firms. The results of the empirical study show the existence of a significant moderating effect, although the consequences on the innovative performance in terms of product or process technologies are found to be different, depending on the practice (storage or transfer) which is considered.

Keywords: Organizational culture, knowledge storage practices, knowledge transfer practices, technology, interaction.

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1. INTRODUCTION

The knowledge-based view of the firm describes companies as institutions that create, transfer and protect knowledge in a more effective way than markets, which justify their existence and boundaries (Kogut and Zander, 1992; Conner and Prahalad, 1996; Liebeskind, 1996). From a strategic viewpoint, it is also suggested that difference in performance between firms is owing to the heterogeneity of their knowledge bases (DeCarolis and Deeds, 1999: 954). Thus knowledge would be considered as the main strategic resource of organizations (Quinn, 1992; Grant, 1996; Hill and Deeds, 1996; Spender and Grant, 1996). In actual fact, certain types of knowledge are scarce; in general the transfer of this asset is not easy, and complex forms of knowledge are difficult to imitate and replicate (Grant, 2002: 177). Therefore, the management of the organizational processes which enable certain kinds of knowledge to become a source of competitive advantage for the firm is an essential task to develop (Grant, 1996; Spender and Grant, 1996; Alavi and Leidner, 2001).

One of the elements which fundamentally affects the capacity of firms to manage knowledge is organizational culture (Davenport, DeLong and Beers, 1998; DeLong and Fahey, 2000). Culture can be considered as an idiosyncratic asset which is accumulated along time and can become a source of competitive advantage if it is valuable, rare and difficult for competitors to imitate (Barney, 1986). In addition, it constitutes an important success factor in the knowledge management (KM) process owing to its important role in establishing the firm's strategic framework and its influence on other organizational aspects such as structure, management style or human resources management (Galán, 2006). Promoting company culture should make KM implementation easier, thus contributing to establish a shared organizational vision, commitment in terms of common projects, team work, autonomy in decision making and a stimulus to continuous innovation (Davenport et al., 1998; Gold, Malhotra and Segars, 2001).

As company culture is built up in and amongst other aspects such as values, beliefs and company work systems, it can encourage or hinder the launching and effectiveness of knowledge management processes such as creation, transfer or application (see e.g., Davenport et al., 1998; Davenport and Prusak, 2000; DeLong and Fahey, 2000; Gold et al., 2001; Janz and Prasarnphanich, 2003; Leidner, Alavi and Kayworth, 2006). Consequently, organizational change which KM processes encourage in order to face strategic changes (e.g., innovation) is affected by the existence of cultural values that could contribute to such change and adjustment (or make it more difficult) if the coherence among these, other organizational aspects, KM objectives and the firm's strategy is at a maximum.

In this paper we will try to analyze the influence of culture on the development of certain KM processes and their joint effects on the technological performance of the firm. The intended objective is two-fold. On the one hand, the link between exploitation KM processes and technological results will be analyzed, bearing in mind that these kinds of processes permit the firm to recover and disseminate valuable knowledge throughout the organization in order to generate value and improve organizational effectiveness[2] (Zack, 1999; Argote and Ingram, 2000). On the other hand, the presence of a moderating effect of a *knowledge-centered culture* (Janz and Prasarnphanic, 2003)

[2] Knowledge dissemination here refers to knowledge which is reproduced throughout the organization (e.g., best practices) and shared knowledge among individuals and groups that implies to some extent the creation of knowledge (e.g., socialization processes).

on the relationship between KM practices and technological results will be studied. Although an important effort has been made over the last few years concerning the empirical analysis of the relationship between culture and certain KM processes (see e.g., Gold et al., 2001; Schulz, 2001; Janz and Prasarnphanich, 2003; Alavi, Kaywoth and Leidner, 2006; Leidner et al., 2006), there is still limited evidence on the interaction effect that is created between culture and KM practices and its impact on firm performance. To be precise, it is specifically this analysis that we shall attempt to carry out with the aim of offering empirical evidence of the effect that is produced when culture and specific KM practices interact with one another.

The structure of the paper is as follows: first, theoretical concepts of exploitation KM practices and knowledge-centered culture will be exposed, highlighting some works that have studied the relationship between these aspects; secondly, the hypothesis, the technical characteristics of the research and the empirical analysis will be shown; finally, we will analyse the results of the empirical analysis, and the main conclusions of the paper will be offered.

2. KNOWLEDGE MANAGEMENT AND ORGANIZATIONAL CULTURE. THEORY AND HYPOTHESIS

2.1. KM practices and firm performance

As Grant (2002: 176) points out, a series of events which have been produced in the two last decades[3] has resulted in the appearance and consolidation of a new management perspective that includes a host of behavioural, technological, organizational and strategic theories and contributions. In basic terms, this (KM) perspective identifies a set of processes through which knowledge is acquired, developed, gathered, shared, applied and protected by the firm in order to improve firm performance (Alavi and Leidner, 2001).

In the strategic management ambit, Grant (2002: 177-178) points out two types of KM contributions in respect of academic and practical areas. On the one hand, there is recognition of the existence of two kinds of knowledge which count on different characteristics and organizational implications for the firm. Thus, knowledge can be explicit or tacit (Polanyi, 1966). Explicit knowledge is that which can be codified and thus incorporated into formal rules, tools or work procedures, while tacit knowledge cannot be easily codified because it is linked to mental models, "know-how" and experience, and can only be transferred through activity (Nonaka and Takeuchi, 1995). On the other hand, the management of knowledge processes which are focused on the improvement of the generation, acquisition and exploitation of knowledge in the firm at different levels –individual, group, organization– also carries importance. Under this guise, knowledge is the firm's main strategic resource and it permits the organization to achieve and hold competitive advantages (Quinn, 1992; Kogut and Zander, 1992; Grant, 1996).

Of the processes previously pointed out, storage and transfer are based on the organization, structuring and dissemination of organizational knowledge in order to

[3] Among them we can point out globalization of the economy, the increasing volatility of competitive environments, a growing tendency towards knowledge intensive products and services, or the significant and rapid advances in information technologies (IT).

effectively exploit it. Although these processes can be independently developed, they can also complement one another, especially when the support of information technologies (IT) is provided (Davenport et al., 1998; Zack, 1999; Alavi and Leidner, 2001). As processes which imply personal involvement, they can be influenced by organizational culture, making this an essential factor so that practices linked to these processes can be successfully developed (Knapp and Yu, 1999; Alavi and Leidner, 2001). The meaning and implications of these processes for innovation in the firm are explained next.

2.1.1. Storage, recovering and structuring of knowledge

Storage of knowledge, along with recovering and structuring, is an important aspect in order to achieve efficient management of this resource for the firm (Zack, 1999). It specifically ensures that the company does not forget everything that it already knows (Alavi and Leidner, 2001: 118). Tan et al. (1999) include a number of repositories as components of this concept, amongst which the following are included: written documents; gathered and structured information in electronic databases; human knowledge that is codified in expert systems; organizational documented procedures (e.g., work handbooks); and tacit knowledge which is accumulated in routines and other intangible assets such as the organizational culture and company structure.

Moreover, Alavi and Tiwana (2003: 107) classify organizational memory as internal and external, depending on the nature of the knowledge gathered –explicit or tacit. Organizational internal memory is referred as knowledge stocks which are instilled in individuals or groups of individuals in the organization –individual skills, routines and culture. On the other hand, organizational external memory is linked to explicit or codified knowledge and it includes formal procedures, notebooks and computer files. Alavi and Tiwana (2003: 108) point out three types of activities that a firm should develop to effectively gather valuable explicit knowledge: (1) define content characteristics of the repositories; (2) establish content sources and specify the means to collect the key knowledge; (3) develop the content of the external memory and specify the means to access the knowledge. In addition to these activities, Zack (1999) also suggests the necessity of developing a process of previous refinement in order to improve the content and value of explicit knowledge by means of labeling, indexing, classification, standardization, integration and categorization procedures. Furthermore, Zack (1999) stresses the importance of assigning organizational roles to carry out these processes.

In terms of positive aspects that knowledge storage can offer the firm, Alavi and Leidner (2001: 118) offer two main points: (1) it makes the implementation of organizational change easier, as a pool of past experiences already exists which the firm can fall back on in order to solve problems; (2) it avoids expending resources to search for solutions to problems that have been before solved by the firm in the past. Apart from these advantages, the firm's own attempt to articulate and codify knowledge generates a process of reflection which facilitates individual learning, the quality of the knowledge stored and thus, its application and transfer throughout the organization (Zollo and Winter, 2002). Stored knowledge is transmitted and incorporated into routines and so it forms part of organizational culture. Moreover, knowledge storage implies a filtered process through which the less relevant or obsolete knowledge is removed or substituted, all of which involves the evolution of routines and organizational culture.

2.1.2. Knowledge transfer and sharing

Knowledge transfer is a process through which an individual or an organizational unit (e.g., a group, department, division)[4] is influenced by the "experience" of another individual or unit which becomes apparent by changes that are produced in the knowledge base or results of the individual or recipient unit[5] (Argote and Ingram, 2000: 151). For Alavi and Tiwana (2003: 110), knowledge transfer is not carried out by organizational units *per se* (e.g., departments, teams, divisions) but instead between: (a) individuals (individual level, in the group, or between groups); (b) between individuals and knowledge repositories (e.g., when an employee downloads a file from a repository of documents); (c) between knowledge repositories (e.g., when a software to filter information is used in order to locate and transfer knowledge between knowledge repositories which are located in different places in the organization).

As knowledge transfer is a process which implies the movement of knowledge from one place to another, carrying this out is often a difficult task for the organization (Alavi and Tiwana, 2003: 110). Thus the prior identification of valuable knowledge, its categorization and the assessment of its potential value for the firm along with the identification of the abilities and instruments to make the transfer possible are all essential issues, as this process is necessary in order for the firm to obtain the maximum benefit from its knowledge assets (Argote and Ingram, 2000).

Moreover, the ease or difficulty of carrying out the knowledge transfer depends on the conditions and aspects that have some influence in the process. Among them, Gupta and Govindarajan (2000) include motivational factors in both recipient and transmitting units, the absorptive capacity of the recipient unit, and the existence and quality of a suitable transmission channel. Overall, the difficulty to transfer knowledge mainly arises out of four kinds of causes: (1) knowledge features, such as complexity, tacitness or the ease with which one is observed or taught (Winter, 1987; Zander and Kogut, 1995; Szulanski, 1996); (2) owing to the ontological dimension of knowledge, which allows for the distinction between personal, group, organizational and inter-organizational knowledge; (3) by the existence, availability and quality of formal and informal channels for knowledge transfer (Gupta and Govindarajan, 2000; Alavi and Leidner, 2001); (4) motivational factors and flair for transfer of the implicated units in the process (Szulanski, 1996; Gupta and Govindarajan, 2000; Szulanski et al., 2004).

Generally, all these factors imply consequences of a strategic nature that are not to do with transfer alone but also affect other aspects such as knowledge protection, appropriation, or value generation because as it is necessary to establish what kind of knowledge is worthy of transmission, sharing or replication by the organization (Oliveira, 1999: 31). Cultural values are also significant here, especially those which refer to making the transfer easier –tacit knowledge in particular–, because they have an important influence on the motivation or willingness to transmit or share knowledge in the firm (Argote and Ingram, 2000).

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[4] Although knowledge transfer implies interaction at an individual level, it transcends to higher levels such as the group, department, division or even the organization.

[5] This definition implies knowledge transfer can be measured: (1) by means of the examination of changes that are produced in the knowledge base of the individual or the recipient unit; (2) through the examination of the performance of the activity (in terms of efficiency, effectiveness, economic return, etc.) (Argote and Ingram, 2000: 151).

Some works have tried to show the effect of knowledge exploitation on company performance. Among them, certain positive relationships have been found between knowledge codification, storage and dissemination and different types of organizational results (e.g., Schulz and Jobe, 2001; Choi and Lee, 2003; Alavi et al., 2006; Haas and Hansen, 2007). Although the level of performance attained will depend on the coherence between the objectives, the company's competitive strategy and knowledge practices (Earl, 2001), the existence of an increased amount of suitable storage and transfer instruments and practices and their use throughout the organization, will lead to a wider spread of knowledge, more effective exploitation and thus to better results for the organization (Szulanski, 1996; Davenport et al., 1998; Oliveira, 1999; Argote and Ingram, 2000).

In relation to innovation, knowledge which is accumulated in repositories through practices that promote its accumulation along with improvement of the access, quality, structuring and availability of this kind of resource will enable the firm to increase its capacity to resolve problems and find solutions in terms of new products or processes (Alavi and Leidner, 2001; Choi and Lee, 2003). The same could be said for transfer practices in the sense of transmission and sharing. As Nonaka and Takeuchi (1995) have shown, transfer processes are at the core of the knowledge creating –innovative– company. As previously pointed out, Alavi and Tiwana (2003) stress the role of interaction between individuals, individuals and repositories, and between repositories, to show how knowledge transfer is carried out. If knowledge transfer is essential for innovation success, the more a firm can effectively transfer its knowledge the more innovative it will be. Thus, the availability of transfer practices in order to make interactions (sharing) along with knowledge replication easier will imply a higher level of innovation for the firm. Overall, we establish the following two hypotheses, distinguishing innovation results in terms of processes (a) or products (b):

H1 (a, b): a greater availability and application of knowledge storage practices by the firm will imply a higher level of innovation results (processes, products).

H2 (a, b): a greater availability and application of knowledge storage practices by the firm will imply a higher level of innovation results (processes, products).

2.2. Organizational culture and its moderating role in the relationship between KM practices and innovation results of the firm

Alavi et al. (2005: 194) point out that organizational culture is a broad concept and thus difficult to define. Moreover, they assert that the open-ended nature of this term has implied a proliferation of diverse ways to explain social behaviors by researchers, but it has also led to confusion and a lack of understanding, owing to the great range of existing conceptualizations of this term.

In general terms, culture can be understood as a set of rules, values and beliefs that are shared by a firm's members and which conditions their behaviors, along with the configuration of the firm's image and identity in relation to its environment (Guerras and Navas, 2007: 620). This concept has been linked to implicit aspects, sometimes of an abstract nature, such as ideologies, beliefs, basic assumptions of behavior or shared values, although other more observable and explicit elements such as rules and organizational practices, symbols, language, rituals, myths and ceremonies have also been included as being related to culture (Alavi et al., 2005: 194).

Some researchers have assigned culture certain levels of involvement as an attempt to narrowly specify the concept. For example, Schein (1985) establishes that culture basically exists in relation to three conceptual levels: basic assumptions, values and artifacts. Basic assumptions or beliefs are interpretative schemes which people use to give sense to activities and human relations that are the basis of collective action. Moreover, they develop over time as a consequence of the strategies that members of a group establish in order to face problems. Regarding values, these are more visible expressions of culture because organizational members hold a greater awareness of them (as compared to, for example, basic assumptions, which are less visible). Values can be understood as social rules that define norms or the context so that social interaction and communication among company members can take place. They even work as a method of social control, establishing what kinds of behavior are correct and/or unacceptable. Finally, artifacts are the most visible expression of culture, including aspects such as technology and patterns of visible or audible behaviors, such as, for example, myths, language, rituals, or organizational ceremonies. Overall, Schein (1985) points out that culture could be represented as a dynamic and continuous interaction among the basic assumptions, values and organizational artifacts of a company.

The KM research stream on organizational culture has essentially focused on values which encourage or hinder knowledge processes of creation and transfer (Alavi et al., 2005). For example, DeTienne and Jackson (2001: 6) point out that if an environment which encourages the sharing of knowledge by providing expectations and incentives does not exist, KM implantation will result in a failure for the organization. In respect of KM strategies development, Earl (2001) and Garavelli et al. (2004), include "knowledge culture" as an essential factor which makes implementation easier, along with other elements such as leadership, human resources practices or the organizational structure. In a similar vein, Gold et al. (2001) showed that a relationship existed between certain organizational values (which were integrated in the so-called "knowledge infrastructure capacities" of the firm along with technology and structure), KM capabilities and a measure of organizational effectiveness. These authors suggest that organizations that have values oriented towards openness and support are prepared to develop behaviors through which the employees share more ideas and knowledge which, in turn, implies they can be more innovative, responding more easily and rapidly to changes and new market opportunities.

Moreover, in a well-known article, Delong and Fahey (1998) identify several values which, from their viewpoint, encourage or hinder the creation, transfer and use of knowledge by the firm. They suggest that while trust and cooperation may lead the employees to share knowledge, the value systems which highlight individual power and competition would imply the adoption of behaviors that lean towards hoarding knowledge in order to dominate and maintain the *status quo*. In a similar vein, Jarvenpaa and Staples (2003) showed that organizational shared values have an important influence on the willingness of knowledge owners to share knowledge with other organizational members. This study, which analyzed university staff, concluded that the existence of certain values that promoted a greater tendency to share knowledge and that established a clear perception of who owned the information, implied a greater use of "collaborative" means to share and exchange knowledge. Other studies basically concluded the same, albeit they only focus on the knowledge creation process. Lee and Choi (2003), for example, find a positive relationship between organizational culture – defined as a set of values that includes cooperation, trust and learning– and the

improvement of the knowledge creation process. Similarly, Lee and Cole (2003) assert that culture acts like a social control mechanism which, depending on whether it promotes critical awareness and open behavior or if instead, it is oriented towards a system that looks to sanction an individual who operates outside of the rules, this will ultimately stimulate or hinder the processes that enables knowledge to be created and disseminated throughout the organization.

Overall, the issue behind all these studies is the manner in which culture influences the development and results of KM practices and processes. In this sense, it seems evident that promoting certain values will lead to behaviors that will produce different types of results for the firm (DeLong and Fahey, 1998). Thus the main problem for the organization is mainly to establish what specific values should be developed and how they should be adjusted to the KM practices implemented by the firm, bearing in mind both its external and internal context (i.e., objectives, strategies, environment).

Moreover, as Alavi and Leidner (2005: 197) argue, most of the works that analyze the relationship between culture and KM practices are focused on both knowledge transfer and creation, and thus other processes such as storage, application or support tools for KM have been researched less. In this sense, we try to analyze the influence of certain kinds of values on knowledge transfer and storage practices. This will provide us with a comparison between these two processes and offer empirical evidence regarding their effects on the technological performance of the company.

As improvement of the innovation capacity and results forms one of the main objectives for the development of KM practices (Davenport et al., 1998; DeLong and Fahey, 1998), technological innovation results will be taken as the dependent variable in this paper. In relation to cultural values, a number of research studies have looked at their direct effect on KM processes (Jarvenpaa and Staples, 2003; Lee and Choi, 2003; Lee and Cole, 2003), and in some cases, the indirect effect, in which certain variables play a mediator role, such as collaborative or cooperative learning (Janz and Prasarnphanic, 2003) or the behavior of KM on its own results (Alavi et al., 2005). In line with this research stream, we propose the existence of a moderating role of "knowledge-centered" values in the relationship between KM practices (storage and transfer) and their results in terms of technological innovation (processes and products). Thus, it is proposed that these kinds of cultural values contribute to improving the effect of KM practices on innovative results, an aspect that has not been previously analyzed, hence hypotheses 3 and 4 establish that:

H3 (a, b): A knowledge-centered culture causes a positive moderating effect on the relationship between knowledge storage practices and innovation results (processes, products) of the firm.

H4 (a, b): A knowledge-centered culture causes a positive moderating effect on the relationship between knowledge transfer practices and innovation results (processes, products) of the firm.

Next, we show the empirical analysis, in which the hypotheses contrast is carried out and the results are shown.

3. EMPIRICAL ANALYSIS

3.1. Population, sample and data collection.

The selected population included industrial companies which correspond to four industries in the Spanish industrial classification CNAE-93. These four industries are included in a section (DL) classified as "manufacturing of electric, electronic and optical material and equipment"[6]. On the one hand, the reason to focus on industrial firms was based on the more simple delineation for product and process innovation in that setting than in service activities. On the other hand, this section was selected because the INE (National Statistics Institute of Spain) classifies it as a technology-intensive sector, which aptly fits our research purpose. Moreover, these four industries guaranteed the provision of an important number of companies in order to apply multivariate statistical techniques for which the sample size is an essential issue. Finally, in order to have minimum dimensioned firms, only those with more than 25 employees were included in the population.

After collecting data and information of companies and establishing an *ad-hoc* database[7], a postal survey was conducted, for which a questionnaire including questions referred to knowledge management, innovation and strategy, was sent to firms. After a month, the survey was resent, and finally, a total of 111 valid questionnaires were received back, representing 13.84% of the response rate. The responding firms had an average age of 33.59 years (SD= 23.79) and an average size (measured by the number of employees) of 275.27 (SD= 565.20). The next step was to establish a comparison – with respect to the number of employees and age– between companies that answered the questionnaire and those that did not, to determine the how representative the sample was. This comparison was made through the *t-test*, which did not yield any important differences between them in relation to size (t= 1.705; p< 0.91) or age (t= 1.927; p< 0.74).

3.2. Measures

3.2.1. Knowledge storage

Knowledge storage measure includes a series of items which try to cover the way the firm implements mechanisms and tools for gathering knowledge and promotes their best use in the organization. Based on existing literature (Davenport et al., 1998; Zack, 1999; Alavi and Leidner, 2001; Bontis et al., 2002; Alavi and Tiwana, 2003; Wang and Ahmed, 2004) a multi-item measure to try to represent the construct was built. To assess the measure liability, the well-known Cronbanch α was used, offering an acceptable value (α= 0.881, 8 items). Also, in order to check convergent validity, the correlation was calculated between the arithmetic mean of the measure and one item included in the questionnaire, referred to the use of tools of data and information management based on IT, that was significant (r= 0.310; p< 0.01; n= 111). Regarding discriminant validity, a factor analysis which included items referred to both practices of knowledge storage and transfer was applied. As table 1 shows, two factors arose with *eigenvalues* above 1.0, with items being grouped as expected.

[6] The DL section of the Spanish CNAE-93 includes four two-digit codified divisions (industries): 30 (manufacturing of office machines and computer equipment, 31 (manufacturing of electric materials and machinery), 32 (manufacturing of electronic material) and 33 (manufacturing of medical-surgical, optical and watch-making materials).

[7] Databases used to gather the information referred to companies were: Fomento de la Producción-30.000 (30.000-Manufacturing Promotion) and SABI (Analysis System of Iberian Accounts).

Table 1. Factor analysis: knowledge storage and transfer practices

Variables*	*Factor 1: Transfer*	*Factor 2: Storage*	Communalities
Storage1	0.376	**0.557**	0.452
Storage2	0.285	**0.571**	0.407
Storage3	0.285	**0.620**	0.466
Storage4	0.425	**0.589**	0.528
Storage5	0.075	**0.848**	0.724
Storage6	0.182	**0.828**	0.720
Storage7	0.403	**0.705**	0.659
Storage8	0.437	**0.656**	0.621
Transfer1	**0.809**	0.220	0.703
Transfer2	**0.798**	0,256	0.702
Transfer3	**0.720**	0.411	0.687
Transfer4	**0.740**	0.188	0.583
Transfer5	**0.693**	0.314	0.578
Transfer6	**0.776**	0.274	0.678
Transfer7	**0.525**	0.259	0.343
% Explained variance	30.614	28.388	Total= 59.002

*See appendix
Total explained variance = 59.002
Kaiser-Meyer-Olkin test= 0.875
Barlett's sphericity test χ^2 = 981.321 significant= 0.000

3.2.2. Knowledge transfer

Again, a multi-item measure was built in order to collect knowledge transfer practices, as carried out by previous studies (Davenport et al., 1998; Zack, 1999; Bontis et al., 2002; Alavi and Tiwana, 2003; Gold et al., 2003; Wang and Ahmed, 2004). Reliability was checked through Cronbach α, which offered a very acceptable value (α= 0.900; 7 items). The correlation between the measure –arithmetic mean– and one item included in the questionnaire that made reference to the understanding of KM for the firm as an instrument that promotes sharing of information and knowledge among employees and departments, was calculated (r= 0.477; p< 0.01; n= 111). Moreover, and in the same way as knowledge storage, discriminant validity was also proved (table 1).

3.2.3. Knowledge-centered culture

The culture of firms that focus their strategy on KM has some distinctive features: it is centred on covering clients' needs; it is linked to the development and encouragement of technological aspects; and it is oriented to encourage creativity (Quinn et al., 1996). Following Alavi and Leidner (2005: 195), culture is conceptualized in this paper in terms of values that should support and promote KM activities[8]. From KM literature, a multi-item measure was constructed which tried to include those values that encourage the development of interactions through the promotion of contacts and relationships for sharing knowledge (Davenport et al., 1998; O'Dell and Grayson, 1998; DeLong and Fahey (2000), the development of a "knowledge vision" which promotes

[8] Alavi and Leidner (2005) point out that cultural values are easier to establish than other concepts such as artifacts or organizational assumptions, which are difficult to conceptualize and delineate, in addition to having an abstract or vague nature.

knowledge transfer (Gupta and Govindarajan, 2000; Gold et al., 2003) and practices supported by IT and collaborative tools (Davenport et al., 1999; Zack, 1999; Alavi and Tiwana, 2003), or the development of a common organizational language which enables effective communication among employees, units and departments (Nonaka and Takeuchi, 1995; Grant, 1996, 2002).

Cronbach α reliability measure offers an acceptable value (α=0.898; 7 items). Moreover, the measure is positively and significantly correlated to an item which makes reference to the importance for the firm of the improvement of its innovation capacity (r= 0.580; p< 0.01; n= 111). This result suggests that managers perceive innovation as being difficult to achieve if cultural values encouraging the use of KM in the firm are not implemented. Discriminant validity was also analyzed through a factor analysis (table 2). All the items grouped into just one factor, showing one-dimensionality.

Table 2. Factor analysis: knowledge-centered culture

Variables*	***Factor: Culture***	**Communalities**
Culture1	0.870	0.757
Culture2	0.749	0.561
Culture3	0.609	0.371
Culture4	0.856	0.733
Culture5	0.856	0.733
Culture6	0.779	0.607
Culture7	0.782	0.611
% Explained variance	62.481	Total= 62.481
*See appendix Total explained variance = 62.481 Kaiser-Meyer-Olkin test= 0.894 Barlett's sphericity test χ^2 = 429.595 significant= 0.000		

3.2.4. Innovation results

The innovation results measure was established bearing in mind the objective of analyzing products and process technologies, owing to the fact that certain companies could be oriented towards one option or another (or both), depending on the orientation of its competitive strategy (Porter, 1985; Zahra and Covin, 1993). Multi-item measures adapted from those previously built and validated by Zahra and Das (1993) were selected. The product innovation measure included four items, with a very acceptable reliability result (α= 0.9077), similar to the process innovation measure (four items, α= 0.9077). Again, a factor analysis was applied in order to analyze discriminant validity, with all the items being grouped as expected (table 3). Moreover, an open question was included in the questionnaire, which inquired about the number of innovations of this kind in the last three years. The correlation between this variable and our measure was significant (r= –0.312, p< 0.01; n= 83)[9]. In a similar way, the correlation between the process innovation measure and the number of new processes obtained in the last three years was also significant (r= –0.327, p< 0.01; n= 91)[10].

[9] In order to normalize the variable, a transformation had to be done through the square root reverse. That is why a negative sign is shown in the correlation result.

[10] In order to normalize the variable, a transformation had to be done through the square root reverse. That is why a negative sign is shown in the correlation result.

Table 3. Factor analysis of the innovation result

Variables*	*Factor 1: Product innovation*	*Factor 2: Process innovation*	*Communalities*
InnProd1	**0.841**	0.201	0.748
InnProd2	**0.821**	0.351	0.796
InnProd3	**0.866**	0.191	0.786
InnProd4	**0.887**	0.200	0.827
InnProc1	0.226	**0.841**	0.759
InnProc2	0.210	**0.905**	0.864
InnProc3	0.176	**0.772**	0.627
InnProc4	0.288	**0.842**	0.792

*See appendix
Total explained variance = 77.491%
Kaiser-Meyer-Olkin test = 0.815
Barlett sphericity test $\chi^2 = 640.178$; significant= 0.000

3.2.5. Control variables

Age, size and industry inclusion (groups 30, 31, 32 and 33 from the DL section of CNAE-93 Spanish industry classification) were used as control variables. These are usually used in the literature related to innovation and KM. Regarding size, it is likely that the most sizable firms invest a greater amount of their budgets in innovation and KM tools than small companies. Moreover, the oldest companies could have a more developed knowledge base than younger firms and thus be at an advantage. In relation to industry inclusion, in terms of attractiveness, certain industries could be in a better position than others depending on their internal structure and existing innovation opportunities.

In order to measure company age, the number of years since it was founded was used, while size was measured through the number of employees figure. Industry inclusion was made operational by three dummy variables (with one of the industries as the reference variable).

3.3. Statistical analysis

Correlation analysis among research variables is shown in table 4. As certain correlation figures are above 0.5, we opted for factor scores instead of arithmetic means as variables in the multiple regression analysis –which was used to contrast the research hypotheses– in an attempt to avoid multicolinearity problems.

Table 5 shows four models corresponding to equation regressions, where the variables were introduced by stages in a hierarchical manner. Thus, the first model only includes the control variables[11]; in the second model, knowledge storage and transfer

[11] As dummy variables that corresponded to industry inclusion along with the age variable did not show significant effects on results, we opted to only consider the company size as a control variable (which had a significant effect on results) in order not to distort the interpretation of the statistical results by incorporating an excess of variables into the regression equation (Hair et al., 1999).

variables were added; in the third model, the knowledge-centered culture variable was included; and in the fourth model, interactions (culture multiplied by both kinds of KM practices) were finally added.

Table 4. Correlation analysis

	1.	2.	3.	4.	5.	6.	7	8.	9.	10.
1. Storage.	1	0.596	0.514	0.296	0.309	-0.062	0.110	-0.114	-0.081	-0.012
2. Transfer	0.596**	1	0.568**	0.362**	0.427**	0.014	0.164	-0.220*	-0.207*	-0.108
3. Culture	0.514**	0.568**	1	0.462**	0.428**	-0.002	0.083	-0.139	0.015	-0.141
4. Product innovation	0.296**	0.362**	0.462**	1	0.511**	-0.015	0.021	-0.113	-0.094	-0.096
5. Process innovation	0.309**	0.427**	0.427**	0.511**	1	0.161	-0.015	-0.184	-0.195*	-0.036
6. Industry (1)	-0.062	0.014	-0.002	-0.015	0.161	1	-0.579**	-0.470**	0.050	0.128
7. Industry (2)	0.110	0.164	0.083	0.021	-0.015	-0.579**	1	-0.287**	0.010	-0.203*
8. Industry (3)	-0.114	-0.220*	-0.139	-0.113	-0.184	-0.470**	-0.287**	1	-0.021	0.168
9. Size[(1)]	-0.081	-0.207*	0.015	-0.094	-0.195*	0.050	0.010	-0.021	1	-0.196*
10. Age [(2)]	-0.012	-0.108	-0.141	-0.096	-0.036	0.128	-0.203*	0.168	-0.196*	1

**The correlation is significant with p< 0,01 (bilateral).
* The correlation is significant with p< 0,05 (bilateral).
Industry (1): inclusion in group 31 (group 30 as reference). *Dummy* variable.
Industry (2): inclusion in group 32 (group 30 as reference). *Dummy* variable
Industry (3): inclusion in group 33 (group 30 as reference). *Dummy* variable.
(1) $1/\sqrt{X}$ function has been used to normalize the variable.
(2) Logarithm function has been used to normalize the variable (LnX).

Regression analysis results show that, first, the four models are significant in relation to process innovation. For product innovation all models are also significant except model 1, where size (control variable) does not show a significant relationship with the dependent variable. In model 2, parameters of storage and transfer are both positive and significant, for both process and product innovation. This result supports H1 (a and b) and H2 (a and b). In turn, the effect of the implementation of both types of KM practices achieves the desired effects in terms of obtaining of a higher level of technological results, both in processes and products.

Regarding model 3, although it is significant for both process and product innovation, it is shown that the introduction of the knowledge-centred culture produces different types of effects on the two kinds of technological results. Thus, the contribution of culture to the variance of innovation process result is not significant in comparison to model 2, while in relation to product innovation, the increase in the model is significant. It may be possible to explain this fact as a knowledge-centered culture is an organizational element that works by promoting creativity in encouraging experimentation and increasing tolerance in respect of errors (Fahey and Prusak, 2000), and as such, has a higher level of affected product than process innovation. This confirms that these two types of innovation are very different in terms of pursued objectives, innovation nature and sources, influential factors and facilitator elements (Zahra and Covin, 1993, 1994).

Finally, model 4 has resulted significant, along with the increase of explained variance for both types of innovation results (in comparison to model 3). When *interactions* that correspond to the product of knowledge storage and transfer by culture are introduced into the model, we obtain two different types of moderating effects. On

the one hand, a moderating effect is produced (significant interaction) through culture on the relationship between knowledge storage and process innovation results, which supports H3a, while no moderating effects are produced between culture and the relationship between knowledge transfer and process innovation results (H3b is thus rejected). On the other hand, the interaction is positive in the case of product innovation as a dependent variable, as thus a moderating effect arises out of this by means of the product of knowledge transfer practices and cultural values, which supports H4b. Moreover, H3b and H4a have to be rejected, as no further significant interaction appeared in the analysis.

Table 5. Multiple regression analysis

	Model 1				**Model 2**			
	Process innov.		**Product innov.**		**Process innov.**		**Product innov.**	
Variables	St. Coeff.	T value	St. Coeff.	T value	St. Coeff.	T value	St. Coeff.	T value
Constant	5.681	22.61***	5.624	22.404	5.453	22.64***	5.475	22.004
Size	-0.203	-2.162**	-0.082	-0.858	-0.109	-1.209	-0.020	-0.206
K. Storage					0.194	2.23**	0.211	2.301**
K. Transfer					0.349	3.85***	0.236	2.474**
F	4.676**		0.737		8.45***		4.08***	
R^2	0.041		0.07		0.192		0.103	
Adjusted R^2	0.032		-0.02		0.169		0.078	
Increase in R^2	0.041		0.07		0.15		0.096	
Increase in F	4.676**		0.737		9.46***		5.72***	
	Model 3				**Model 4**			
	Process innov.		**Product innov.**		**Process innov.**		**Product innov.**	
Variables	St. Coeff.	T value	St. Coeff.	T value	St. Coeff.	T value	St. Coeff.	T value
Constant	5.523	22.4***	5.675	23.695	5.396	21.7***	5.664	23.411
Size	-0.138	-1.490	-0.103	-1.124	-0.136	-1.485	-0.121	-1.330
K. Storage	0.129	1.296	0.022	0.220	0.181	1.729*	-0.045	-0.434
K. Transfer	0.242	1.998**	-0.076	-0.633	0.240	2.015**	-0.086	-0.721
Culture	0.167	1.325	0.488	3.885***	0.230	1.753*	0.562	4.309***
Stor x Cult					0.180	1.927*	-0.114	-1.221
Transf x Cult					0.112	1.212	0.184	1.987**
F	6.82***		7.24***		5.61***		5.82***	
R^2	0.205		0.215		0.245		0.252	
Adjusted R^2	0.175		0.185		0.201		0.208	
Increase in R^2	0.013		0.112		2.756		0.037	
Increase in F	1.756		15.1***		0.040*		2.571*	

* Significant p< 0,1
** Significant p< 0,05
*** Significant p< 0,01

Overall, the empirical results show that culture is an important moderating variable in the relationship between KM and technology generation, depending on the

type of KM practices which are developed and innovation results that these practices encourage. Furthermore, it reflects two important facts: on the one hand, the objectives that are followed through these KM practices; and on the other hand, the different nature of process and product innovation. Results in process innovation, which is basically oriented to objectives related to efficiency, and therefore is linked to cost control (Zahra and Das, 1993; Zahra and Covin, 1993, 1994), are amplified when knowledge storage practices are reinforced by cultural values that encourage, among other aspects, the access to better structured information and knowledge, the non replication of work in progress or work that has already been developed by the firm, or not wasting organizational resources by being able to gain access to solutions to problems previously encountered and knowledge sources (Davenport et al., 1998; Zack, 1999). On the contrary, results in product innovation, which used to be more oriented to a differentiation strategy (Zahra and Covin, 1994), are amplified by the interaction between a set of practices that specifically pursue knowledge generation through encouraging socialization processes (Nonaka and Takeuchi, 1995) along with replication activities of existing knowledge, and "knowledge-centered" cultural values that contribute to promote these practices throughout the organization.

4. CONCLUSIONS

The focus of this paper has been on the analysis of relationships among certain KM practices, organizational culture and innovation results of the firm. After carrying out an empirical analysis in a set of innovation-intensive industrial companies, results have shown that both practices of knowledge storage and transfer produce a positive and significant effect on innovation results. More importantly, it has shown that a set of "knowledge-centered" cultural values causes a multiplying effect when it interacts with these types of practices. In statistical terms, this moderating effect helps to significantly explain the variance of the dependant variable (innovation result) both in processes (if the interaction is caused by the product of storage and culture) and in products (if the interaction is caused by the product of transfer and culture) to a greater extent than if interactions are not included in the model (i.e., if model 4 is compared to model 3). Therefore, the results of this study suggest –in line with the previous literature– that the development of an organizational culture which supports KM is key in order for the company to be able to appropriate its knowledge base value (Gold et al., 2001; Janz and Prasarnphanic, 2003; Lee and Choi, 2003).

An interesting finding of this paper refers to the nature of the interactions that are produced between KM practices and cultural values which cause positive effects on both types of innovation results. From a prescriptive viewpoint, it would imply the selection of specific types of practices in order to improve results related to certain kinds of technologies. Thus companies more oriented towards process innovations (more usually engaged in cost strategies) should promote practices that enable the company to reach high levels of efficiency (Porter, 1985; Zahra and Covin, 1993), while those more oriented towards product innovation should be focussed on practices with objectives related to the improvement of innovative capacity in order to differentiate their products (Porter, 1985; Zahra and Covin, 1993). In both cases, the adjustment of the KM practices to certain "knowledge-centered" cultural values is a key aspect in achieving an optimal level of performance (Leidner et al., 1996), as has been observed in our analysis.

Overall, the findings lead to the conclusion that a culture oriented towards innovation and KM is a relevant factor in order that these practices efficiently contribute to the improvement of a company's technological results. Culture constitutes the general *framework* in which company strategy in relation to KM is established, in other words, the KM conception, objectives and specific values related to KM (Earl, 2001). Moreover, it importantly influences certain aspects such as work autonomy, motivation and decision-making systems (Galán, 2006). All these factors affect the efficiency through which knowledge is gathered and are essential to making relationships among employees and teams easier in order for them to share and transmit tacit knowledge. Culture orientation is an important factor in ensuring that KM contributes to company performance, and the way cultural values evolve in a coherent manner regarding factors such as the organizational structure, KM practices, managing style and HR policies, is an essential aspect which must be managed by the firm (Earl, 2001; Garavelli et al., 2004).

Some limitations of this study are pointed out next. First, the transversal nature of this research is a problem in terms of analyzing relationships between variables that evolve along time and have important differing effects. In this sense, the design of a longitudinal study could be an interesting future research option in order to validate our empirical results. On the other hand, a re-conceptualization of some variables may be necessary as well, in order to obtain more accurate results. For example, in the case of the knowledge transfer variable, we have not distinguished between sharing and replication, both of which are processes that, albeit they refer to transfer, have been made operational as opposite variables (see e.g., Haas and Hansen, 2007). Also, the design of more complex models and their testing through other multivariate statistical techniques could be a future research option. For example, the introduction of mediation relations and simultaneous equations would be possible in order to carry out an analysis using structural equation models (SEM). Finally, the analysis of the effect of exploration KM practices, such as creation or external acquisition on technological results and their adjustment with cultural values, continues to pose a line of research for the future.

In conclusion, the obtained results support the thesis that, from a knowledge-based view of the firm, connections exists among organizational culture, KM activities and firm performance, as a result of their application (Davenport et al., 1998; Delong and Fahey, 1998; Jarvenpaa and Staples, 2003; Janz an Prasarnphanich, 2003; Lee and Choi, 2003; Lee and Cole, 2003; Alavi et al., 2005; Leidner et al., 2006). Managers' perception of the role of KM practices and processes in companies and their commitment regarding the development of a culture that promotes and encourages these practices towards organizational objectives will be essential to achieving competitive advantages based on technological innovation.

REFERENCES

Alavi, M. and Leidner, D. (2001): "Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues", *MIS Quarterly*, 25 (1), 107-136.

Alavi, M. and Tiwana, A. (2003): "Knowledge Management: The Information Technology Dimension", en Easterby-Smith, M. y Lyles, M.A. (Eds.): *Organizational Learning and Knowledge Management*, London: Blackwell Publishing, 104-121.

Alavi, M., Kayworth, T. and Leidner, D. (2005): "An Empirical Examination of the Influence of Organizational Culture on Knowledge Management Practices", *Journal of Management Information Systems*, 22 (3), 191-224.

Argote, L. and Ingram, P. (2000): "Knowledge Transfer: A Basis for Competitive Advantage in Firms", *Organizational Behaviour and Human Decision Processes*, 82 (1), 150-169.

Barney, J.B. (1986): "Strategic Factors Market: Expectations, Luck and Business Strategy", *Management Science*, Vol. 32, 1231-1241.

Bontis, N, Crossan, M. and Hulland, J. (2002): "Managing an Organizational Learning System by Aligning Stocks and Flows", *Journal of Management Studies*, 39 (4), 437-469.

Choi, B. and Lee, H. (2003): "An empirical investigation of knowledge management styles and their effect on corporate performance", *Information & Management*, 40, 403–417.

Conner, K.R. and Prahalad, C. (1996): "A Resource-Based Theory of the Firm: Knowledge *versus* Opportunism", *Organization Science*, Vol. 7, 477-501.

Davenport, T., DeLong, D. and Beers, M. (1998): "Successful Knowledge Management Projects", *Sloan Management Review*, 39 (2), 43-57.

Davenport, T. and Prusak, L. (1998): *Working Knowledge*, Cambridge, MA: Harvard Business School Press.

DeCarolis, D.M. and Deeds, D. (1999): "The Impact of Stocks and Flows of Organizational Knowledge on Firm Performance: An Empirical Investigation of the Biotechnology Industry", *Strategic Management Journal*, 20, 953-968.

DeLong, D.W. and Fahey, L. (2000): "Diagnosing Cultural Barriers to Knowledge Management", *Academy of Management Executive*, 14 (4), 113-127.

DeTienne, K.B. and Jackson, L.A. (2001): Knowledge Management: Understanding Theory and Developing Strategy, *Competitiveness Review*, 11 (1), 1-11.

Earl, M. (2001): "Knowledge Management Strategies: Toward a Taxonomy", *Journal of Management Information Systems*, 18 (1), 215-233.

Fahey, L. and Prusak, L. (1998): "The Eleven Deadliest Sins of Knowledge Management", *California Management Review*, 40 (3), 265-276.

Galán, J.I. (2006): *Diseño Organizativo*, Madrid: Thomson.

Garavelli, C. Gorgoglione, M. and Scozzi, B. (2004): "Knowledge Management Strategy and Organization: a Perspective of Analysis", *Knowledge and Process Management*, Vol. 11 (4), 273-282.

Gold, A., Malhotra, A. and Segars, A. (2001): "Knowledge Management: An Organizational Capabilities Perspective", *Journal of Management Information Systems*, 18 (1), 185-214.

Grant, R.M. (1996): "Toward a Knowledge Based Theory of the Firm", *Strategic Management Journal*, 17, 109-122.

Grant, R.M. (2002): *Contemporary Strategy Analysis. Concepts, Techniques and Applications (Fourth Edition)*, Boston: MA, Blackwell Publishers.

Gupta, A. and Govindarajan, V. (2000): "Knowledge Flows within Multinational Corporations", *Strategic Management Journal*, 21, 473-496.

Hair, J., Anderson, R., Tatham, R., and Black, W. (1999): *Análisis Multivariante* (5ª edición), Madrid: Prentice-Hall.

Haas, M.R. and Hansen, M.T. (2007): "Different Knowledge, Different Benefits: Toward a Productivity Perspective on Knowledge Sharing in Organizations", *Strategic Management Journal*, 28 (11), 1133-1154.

Hill, C.W. and Deeds, D.L. (1996): "The Importance of the Industry Structure for the Determination of Firm Profitability: A Neo-Austrian Perspective", *Journal of Management Studies*, Vol. 33 (4), 429-451.

Huber, G. (1991): "Organizational Learning: The Contributing Processes and the Literatures", *Organization Science*, 2 (1), 88-115.

Janz, B.D. and Prasarnphanic, P. (2003): "Understanding the Antecedents of Effective Knowledge Management: The Importance of a Knowledge-Centered Culture", *Decision Science*, 34 (2), 351-384.

Jarvenpaa, S.L. and Staples, S.D. (2003): "Exploring Perceptions of Organizational Ownership of Information and Expertise", *Journal of Management Information Systems*, 18 (1), 151-183.

Knapp, E. and Yu, D. (1999): "How Culture Helps or Hinders the Flow of Knowledge", *Knowledge Management Review*, 2 (1), 16-21.

Kogut B. and Zander U. (1992): "Knowledge of the Firm, Combinative Capabilities and Replication of Technology", *Organization Science*, 3 (3), 383-397.

Lee, H. and Choi, B. (2003): "Knowledge Management Enablers, Processes, and Organizational Performance", *Journal of Management Information Systems*, 20 (1), 179-228.

Lee, G.K. and Cole, R.E. (2003): "From a Firm-based to a Community-based model of Knowledge Creation: The Case of the Linux Kernel Development", *Organization Science*, 14 (6), 633-649.

Leidner, D., Alavi, M. and Kayworth, T. (2006): "The Role of Culture in Knowledge Management: A Case Study of Two Global Firms", *International Journal of e-Collaboration*, 2 (1), 17-40.

Liebeskind, J.P. (1996): "Knowledge, Strategy, and the Theory of the Firm", *Strategic Management Journal*, 17 (1), 93-107.

Nelson, R. and Winter, S. (1982): *An Evolutionary Theory of Economic Change*, Cambridge, MA: Harvard University Press.

Nonaka, I. and Takeuchi H. (1995): *The Knowledge Creating Company: How Japanese Companies Create the Dynamics of Innovation*, Nueva York: Oxford University Press.

O'Dell, C. and Grayson, C. (1998): "If Only We Knew what We Know: Identification and Transfer of Internal Best Practices", *California Management Review*, 40 (3), 154-174.

Oliveira, M. (1999): "Core Competencies and the Knowledge of the Firm", in Hitt, M.A. *et al*. (Eds.): *Dynamic Strategic Resources: Development, Diffusion and Integration*, New York: John Wiley & Sons, 17-41.

Polanyi, M. (1966): *The Tacit Dimension*, New York: Anchor Day Books.

Porter, M. (1985): *Competitive Advantage*, New York: Free Press.

Quinn, J. B. (1992): *The Intelligent Enterprise*, New York: Free Press.

Quinn, J.B., Anderson, P. and Finkelstein, S. (1996): "Leveraging intellect", *Academy of Management Executive*, 10, 7–27.

Schein, E.H. (1985): "How Culture Forms, Develops and Changes", in Kilmann, R.H., Saxton, M.J. and Serpa, R. (Eds): *Gaining Control of the Corporate Culture*, San Francisco: Jossey Bass, 17-43.

Schulz, M. (2001): "The Uncertain Relevance of Newness: Organizational Learning and Knowledge Flows", *Academy of Management Journal*, 44 (4), 661-681.

Schulz, M. and Jobe, L.A. (2001): "Codification and Tacitness as Knowledge Management Strategies: An Empirical Exploration", *Journal of High Technology Management Research*, 12, 139-165.

Spender, J-C. and Grant, R.M. (1996): "Knowledge and the Firm: Overview", *Strategic Management Journal*, 17 (Winter Special Issue), 5-9.

Szulanski, G. (1996): "Exploring Internal Stickiness: Impediments to the Transfer of Best Practice Within the Firm", *Strategic Management Journal*, 17, Winter Special Issue, 27-43.

Szulanski, G., Cappetta, R. and Jensen, R.J. (2004): "When and How Trustworthiness Matters: Knowledge Transfer and the Moderating Effect of Causal Ambiguity", *Organization Science*, 15 (5), 600-613.

Tan, S.S., Teo, H.H., Tan, B.C. and Wei, K.K. (1999): "Developing a Preliminary Framework for Knowledge Management in Organizations", in Hoadley, E. and Benbasat, I. (Eds.): *Proceedings of the Fourth Americas Conference in Information Systems*, August, Baltimore, MD, 629-631.

Venkatraman, N. (1989): "The Concept of Fit in Strategy Research: Toward Verbal and Statistical Correspondence", *Academy of Management Review*, 14 (3), 423-444.

Wang, C.L. and Ahmed, P.K. (2004): "Development of a Measure for Knowledge Management: An Empirical Test and Validation of the Knowledge Management Orientation Construct", *Paper presented at the Fifth European Conference on Organizational Knowledge, Learning and Capabilities*, Innsbruck (Austria), 2-4 April.

Winter, S.G. (1987): "Knowledge and Competence as Strategic Assets", in Teece, D.J. (Ed.): *The Competitive Challenge: Strategies for Industrial Innovation and Renewal*, Cambridge, MA: Ballinger Publishing Company, 159-184.

Zack, M. (1999): "Managing Codified Knowledge", *Sloan Management Review*, Summer, 45-58.

Zahra, S.A. and Covin, J.G. (1993): "Business Strategy, Technology Policy and Firm Performance", *Strategic Management Journal*, 16, 451-478.

Zahra, S.A. and Covin, J.G. (1994): "The Financial Implications of Fit between Types and Sources of Innovation and Competitive Strategy", *Journal of High Technology Management Research*, 5, 183-212.

Zahra, S.A. and Das, S.R. (1993): "Innovation Strategy and Financial Performance in Manufacturing Companies: An Empirical Study", *Production and Operations Management*, 2 (1), 15-37.

Zander, U. and Kogut, B. (1995): "Knowledge and the Speed of the Transfer and Imitation of Organizational Capabilities: an Empirical Test", *Organization Science*, 6, 76-92.

Zollo, M. and Winter, S.G. (2002): "Deliberate Learning and the Evolution of Dynamic Capabilities", *Organization Science*, 13 (3), 339-351.

APPENDIX. Research variables

Knowledge storage practices. In your company: (from 1 – totally disagree to 7 – totally agree):

- Organizational procedures are documented through work procedures, written protocols, handbooks, etc (Storage1).
- Databases that allow gathered knowledge and experiences to be used later are available in the company (Storage2).
- There are phone or e-mail directories (referring to departments and sections) to find experts in specific areas (Storage3).
- It is possible to access knowledge repositories, databases and documents through some kind of internal computer network (such as an intranet) (Storage4).
- There are customer databases with updated information about them (Storage5).

- Databases are frequently updated and information is renewed (Storage6).
- There are procedural company handbooks about problems and methods that have been successfully applied.
- IT is used to handle, structure and improve the quality of information and knowledge and encourage communication and accessibility among individuals (Storage8).

Knowledge transfer practices. In your company: (from 1 – totally disagree to 7 – totally agree):

- Periodical reports are made and distributed to all organizational members in which the firm's achievements are explained (Transfer1).
- Periodical meetings are held to inform the employees about organizational developments (Transfer2).
- There are formal mechanisms to allow the sharing of best practices between areas and/or departments (Transfer3).
- There are projects with interdisciplinary teams in order to share knowledge (Transfer4).
- There are employees that compile suggestions from employees, customers and suppliers and distribute structured reports of these within the firm (Transfer5).
- There are communities of practices or groups of learning to share knowledge and experiences (Transfer6).
- All employees can access organizational databases and knowledge repositories (Transfer7).

Knowledge-centered culture principles and leadership. In our company: (from 1 – totally disagree to 7 – totally agree):

- There is a common language to support knowledge exchange and sharing between employees and departments (Culture1).
- Employees experiment and implement new ideas in their working day (Culture2).
- Mistakes are a learning consequence and are tolerated up to a certain limit (Culture3).
- The firm's culture is based on confidence and openness (Culture4).
- We encourage employees to share knowledge, at an informal level (Culture5).
- Employees have responsible behavior and a high learning disposition (Culture6).
- All organizational members perceive the same purpose and they feel bound to it (Culture7).

Process innovation results. Assessment of the level of technological results obtained over the last 3 years for this company: (1 – very low to 7 – very high):

- Development of new production methods and procedures (Process1).
- Development of improvements for existing methods and procedures (Process2).
- Introduction of more new (or improved) methods and procedures than its major competitors (Process3).
- Introduction of more new (or improved) methods and procedures than 3 years ago (Process4).

Product innovation results. Assessment of the level of technological results obtained over the last 3 years for this company: (1 – very low to 7 – very high):

- Development of new products (Product1).
- Modification and/or improvement of existing products (Product2).
- Introduction of more new (or improved) products than its major competitors (Product3).
- Introduction of more new (or improved) products than 3 years ago (Product4).