Do best and worst innovation performance companies differ in terms of intellectual capital, knowledge and radicalness?

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Accepted 5 October, 2011

This paper has differentiated “best” from “worst” innovative companies, taking into account three separate bodies of literature, that is, the intellectual capital, knowledge-based view and innovation literatures. Based on a sample of 181 firms that belong to the manufacturing and services industries, our findings showed that the best innovation performance companies (considering both financial and nonfinancial dimensions of innovation success), which also presented higher firm performance, had systematically higher scores for all dimensions of intellectual capital (human, organizational and social capital), for knowledge exchange and combination than the worst innovation performance companies. However, with regard to knowledge types, our results were not as conclusive. There were no differences between best and worst innovation performance companies in terms of their systemic knowledge. Codified and simple knowledge were related to best innovation performance companies only in their financial dimension. Finally, regarding radicalness, firms with more innovation success were those which provided new products or services that incorporated new technology and new customer benefits (uniqueness), while firms with less innovation success launched new products or services that were unfamiliar or difficult to understand by customers. These findings contribute to the innovation literature providing a pretty full picture of best and worst innovative companies.

Key words: Intellectual capital, human capital, social capital, organizational capital, knowledge, radicalness, innovation performance.

INTRODUCTION

Looking for the features that explain the differences between the most and the least successful innovative companies has been a challenging concern for both academics and practitioners. As Slowinski and Sagal (2010) suggest, firms are complex entities and a practice that works well in one firm may not produce the same results in another. However, establishing a set of “best practices” is important as they can work well in a wide variety of firms and can be adapted to a wide range of environments. Besides, these practices can allow us not only to understand the characteristics of successful organizations but develop benchmarks for “excellent organizations” (Cocks, 2009). The patterns or configurations of successful innovative firms could act as reference models that simplify and accelerate process innovation (Barros, 2007).

Best practices, which have been defined as tactics or methods that have been shown through real-life implementation to be successful (Dooley et al., 2002), have been studied from several approaches. One of the most extensive studies in this field has been the Product Development and Management Association (PDMA) survey (Barczak et al., 2009; Griffin, 1997), which tries to determine which practices are more commonly associated with firms that are more successful in new product
development (NPD). Dooley et al. (2002) analyze a large and heterogeneous number of potential best practices for each stage of the NPD process, from the customer requirements stage to the product improvement and disposal stage. Cooper et al. (2004a, 2004b) also discuss the results of the American Productivity and Quality Center study on performance and best practices in new product development. They highlight a set of best practices organized into three categories: The culture and climate within the business in support of product innovation, the role of senior management and the nature of project teams and how they are organized.

Nevertheless, these previous researches lack a global reference to the mechanisms that successful companies use to manage knowledge in their innovation activities. Edvinsson and Sullivan (1996) discuss the role that knowledge plays in the process of innovation, and develop a model for managing the firm's intellectual capital. Ross and Ross (1997) and Bontis et al. (1999) review the different tools available to measure the intangible resources, those considered key to develop innovation. Although other researchers such as Coombs and Hull (1998) and Hidalgo and Albors (2008) examine certain knowledge management practices for innovation, they propose them as a set of techniques and tools more than as tactics (Dooley et al., 2002) useful for success.

Then, beyond the search for a set of the specific best practices for innovation success, our approach tries to improve our understanding of the differential features that characterize the most successful companies in terms of innovation activities, focusing on several aspects related to the way in which these companies are managing their knowledge and the type of innovation developed. One interesting approach to deal with this issue is the intellectual capital perspective. Stewart (1997) defines intellectual capital as a set of knowledge, information, intellectual property and experience that can be put to use to create wealth in the organization. Nahapiet and Ghoshal (1998) and Subramaniam and Younct (2005) conceptualize it as the sum of all knowledge that firms utilize for competitive advantage. While the terms used to label the various intellectual capital components may differ, they consist of three basic components (Nahapiet and Ghoshal, 1998; Reed et al., 2006; Subramaniam and Younct, 2005): Human capital, organizational capital and social capital. Human capital, at an individual level, refers to the knowledge and capabilities of the employees who work for the firm. The second aspect, organizational capital, corresponds to those components of explicit knowledge that may be documented and recorded. Third, social capital can be defined as knowledge resources generated by interpersonal networks, which are, therefore, embedded and available within those networks of relationships (Nahapiet and Ghoshal, 1998). Regarding the last aspect of intellectual capital, social capital, it must be considered both in its internal and external perspective in order to embrace the knowledge that is being shared between the individuals pertaining to the company and individuals pertaining to the companies' partners for innovation activities.

This approach (intellectual capital) would not be complete if we did not consider the dimensions and processes of knowledge that are embedded in the innovation activities (Bontis, 1998), given that the ability to create new knowledge enables firms to both innovate and to outperform their rivals (Grant, 1996; Kogut and Zander, 1992). We analyze the dimensions of knowledge (systemic versus autonomous; tacit vs. explicit; complex vs. simple) and the knowledge exchange and combinations that lead to more successful innovations.

Finally, innovativeness or radicalness of innovation, which can be conceptualized as the degree of new knowledge embedded in the innovation (Dewar and Dutton, 1986), is the characteristic of new products or services that we study as another determinant of innovation success (Szymanski et al., 2007).

Based on the previous statements, the main objective of this research is to identify the features that differentiate the most successful innovative companies from the least successful, in relation to the three relevant topics in the field of innovation research, which are intellectual capital, knowledge and radicalness. Therefore, our research question is: “Do best and worst innovation performance companies differ in terms of intellectual capital, knowledge and radicalness?”

Our criterion to identify the best and the worst innovation performance companies is innovation success (or new products or innovation performance), which has been usually considered as commercial success, in terms of sales, profitability or market share from new products (Kock, 2007; Montoya-Weiss and Calantone, 1994; Szymanski et al., 2007). All of these issues are indicators of the financial dimension of innovation performance. Nevertheless, few studies capture the nonfinancial performance of innovation, which also represents positive consequences to the firm: company image, retention of existing customers, attraction of new customers, profitability of other company products, competitive advantage, etc. (Avlonitis et al., 2001; Salavou and Avlonitis, 2008). We will study both financial and nonfinancial innovation success.

This paper makes several contributions to research. First, we bring together three separate bodies of literature—the intellectual capital, knowledge-based view and innovation literatures- providing a more accurate description of the best and worst innovative companies. Second, we focus on the R and D and innovation departments. Most of the aspects of intellectual capital and knowledge have been studied previously by referring to the whole organization (Subramaniam and Younct, 2005). Our approach provides a richer understanding of the determinants of innovation success, with direct
impli-cations for R and D managers. Third, our research contributes to the innovation literature examining both the financial and nonfinancial performance dimensions of innovation success (Avlonitis et al., 2001).

**Conceptual framework: Separating best from worst innovation performers**

Three topics (intellectual capital, knowledge and radicalness) have been chosen to explain the features of the most successful companies with regard to their innovation activities.

**Intellectual capital**

Edvinsson and Malone (1997) posit that intellectual capital is a two-level construct: Human capital (the knowledge created by, and stored in a firm’s employees) and structural capital (the embodiment, empowerment, and supportive infrastructure of human capital). They then divide structural capital into organizational capital (knowledge, created by, and stored in a firm’s information technology systems and processes that speeds the flow of knowledge through the organization) and customer capital (the relationships that a firm has with its customers). Bontis (1998) also discusses customer capital as one aspect of what he calls ‘relational capital’, or the capital that encompasses all external relationships. As Reed et al. (2006) suggest this relational capital view is similar, to that referred to as external social capital by sociologists (Burt, 1992; Coleman, 1988) and management theorists (Nahapiet and Ghoshal, 1998; Stewart, 1997; Youndt et al., 2004).

As it is clear from above, the names of the various intellectual capital components differ; however, three basic components of intellectual capital can be considered: Human capital, organizational capital and social capital (Subramaniam and Youndt, 2005), which represent different approaches adopted by organizations for accumulating and utilizing the knowledge. In the paragraphs below we propose how and why these issues are present in the most successful innovative companies.

Human capital at an individual level refers to the knowledge and capabilities of the employees who work for the firm. The second aspect, organizational capital, corresponds to those components of explicit knowledge that may be documented and recorded. The proper management of organizational capital may lead to the preservation of the knowledge generated within the firm through codification and documentation in some way that can be accessed and used readily by any company member, which has been called codification strategy (Hansen et al., 1999). Third, social capital can be defined as knowledge resources generated by interpersonal networks, which are, therefore, embedded and available within those networks of relationships (Nahapiet and Ghoshal, 1998). Social capital affects information and it influences and promotes solidarity among these actors (Adler and Kwon, 2002). Regarding this last aspect of intellectual capital, social capital, it must be considered both in its internal and external perspective in order to embrace the knowledge that is being shared between the individuals pertaining to the company and individuals pertaining to the companies’ partners for innovation activities.

**Human capital: How should be the individual knowledge involved in innovation activities?**

The existing literature on innovation has emphasized the role of individual knowledge as one of the primary resources for innovation, and it is clear that a firm’s ability to produce new products and other organizational capabilities is inextricably linked to its human capital (Laursen, 2002; Lopez-Cabrales et al., 2006). Then, we expect that the most innovative companies will have the highest levels of human capital.

Our reasoning must consider the two sides of this individual knowledge. First, its value, that is, “its potential to improve the efficiency and effectiveness of the firm, exploit market opportunities, and/or neutralize potential threats” (Lepak and Snell, 2002); second, its uniqueness, that is, the degree to which an employee is irreplaceable and idiosyncratic, and his or her rare and firm-specific knowledge, skills, and abilities (Barney, 1991) are difficult to transfer to other positions and for other firms to duplicate (Lengnick-Hall and Lengnick-Hall, 2003; Lepak and Snell, 1999).

In companies with a high level of value in its human capital, employees represent the greatest collection and diversity of skills, they are flexible in acquiring new skills, are willing to experiment and apply new procedures and can contribute to identifying new market opportunities (Costa and McCrae, 1992; Subramanian and Youndt, 2005; Taggar, 2002). Thus, companies with this kind of employee are more likely to enhance their innovative performance.

Furthermore, in companies with a high level of knowledge uniqueness, employees are irreplaceable and idiosyncratic. They can generate competitive differentiation because their specialized knowledge, which contributes to the development of new ideas and products, may be difficult for other firms to duplicate (James, 2002; Lepak and Snell, 1999; Lengnick-Hall and Lengnick-Hall, 2003). Thus, we expect that the value and uniqueness of human capital will be much higher in the most successful innovative companies than in the least successful ones.

**Organizational capital: Why preserving knowledge through documentation is important for innovation activities?**

Organizational capital represents the memory of the
organization and it has been defined as archival information about the firm’s history that could be considered in current decision making processes (Walsh and Ungson, 1991). This memory of the organization is expressed through organization processes, databases, documents, patents and manuals that organizations use to store and retain knowledge (Wright et al., 2001; Youndt et al., 2004). The question is why organizations should be interested in preserving all this knowledge. Valuable knowledge, once captured and codified, can be systematically transmitted and disseminated, and other individuals can use it in new contexts (Sorensen and Lundh-Snis, 2001). In this way, proper and active consultation of up-to-date reliable and accessible internal knowledge could have a positive influence on innovation success, as has been demonstrated by Leenders and Voermans (2007). Thus, organizations where organizational capital is appropriately managed have institutionalized knowledge and codified experience stored in databases, routines, etc., all of which are available for its members, who can put them into practice for new products. We expect that the level of organizational capital will be much higher in the most successful innovative companies than in the least successful ones.

Internal social capital: What should be the relationships between individuals involved in innovation activities?

Two main dimensions of social capital are noteworthy: The structural dimension and the relational dimension (Granovetter, 1992; Nahapiet and Ghoshal, 1998). Our research is focused on the relational dimension, as it can better explain innovation performance (Moran, 2005). The central argument is that innovation mostly depends on the quality of relationships established between the people involved (relational dimension), rather than on the density, connectivity and hierarchy of such relationships (structural dimension). We expect that the quality of relationships between people involved in innovation activities will be much better in the most successful innovative companies than in the least successful ones.

The importance of the relational dimension of social capital for innovation is based on its effect on the three conditions for knowledge exchange and combination, which are required by successful innovations. These conditions are access to parties for exchange and combination of knowledge, anticipation of value through exchange and combination, and the motivation of parties to engage in knowledge creation through data exchange and combination (Nahapiet and Ghoshal, 1998).

Beyond the arguments of Nahapiet and Ghoshal, the importance of the relational dimension of social capital for innovation can be mainly argued in terms of relational closeness and trust. The reasoning that supports this argument has to do with the idea of innovation as the result of the cooperation and interpersonal relations established between the people involved. When two parties trust each other, they are more willing to share their resources, which in turn will improve innovation performance (Tsai and Ghoshal, 1998). Furthermore, Moran (2005) suggests that although an actor may have access to several people who are potentially critical sources of information for innovation, it is the quality of past interactions that will influence whom he or she is likely to approach and engage. Then, if there is a close relationship, people will be more willing to support and encourage innovative ideas, as the individuals involved are able to give the confidence needed to turn ideas into successful projects.

Summarizing, where trust and friendship levels are high (high level of social capital), people are more willing to engage in social exchange and cooperative interactions, such as relying on others, asking for help, and having spontaneous conversations and unplanned meetings, as well as sharing information, knowledge and resources (Lee et al., 2005). Then, one could expect that most successful innovative companies have a high level of social capital than the least successful ones.

External social capital: What should be the relationships with the partners for innovation activities?

Besides internal relationships, firms establish in the course of their business activities a variety of interfirm ties (buyer–supplier relationships, strategic alliances, and joint ventures, among others) that enable them to exchange a variety of information and knowledge, and overcome the inherent risks associated with the innovation process (Gopalakrishnan et al., 2008; Sivadas and Dwyer, 2000). As with internal social capital, the partners’ intention and willingness to cooperate and exchange knowledge depends on trust (Fukuyama, 1995; Kale et al., 2000; Ring and Van de Ven, 1994) or on the level of social capital embedded in the relationships (Yli-Renko et al., 2001). The literature review by De Man and Duysters (2005) suggests that intensive types of alliances have a positive impact on innovation because these close and trustworthy collaborations between organizations can promote a more efficient transfer of complementary knowledge.

This idea that strong interfirm linkages, often characterized by long-lasting, repeated and socially dense relationships, favor innovation success is not new in the managerial arena. This relational embeddedness enhances information utilization and enables firms to proceed more efficiently by reducing concerns about the loss of proprietary skills and knowledge and diminishing the likelihood of conflict regarding goals and implementation. For Inkpen and Tsang (2005), an atmosphere of
trust will contribute to the free exchange of knowledge between partners, because decision makers should not feel that they have to protect themselves from others' opportunistic behavior. This provides a normative environment that guarantees the actual execution of knowledge recombinant processes (Padula, 2008). Trust is needed for collaboration in innovation activities because the drafting of complete, detailed contracts can make the creation of knowledge and innovation difficult or even impossible (Blomqvist et al., 2005). Besides, highly interconnected (cohesive) network structures promote more intense interactions between partner firms' personnel, allowing knowledge to be more meaningfully understood and more effectively exchanged, combined and utilized (Coleman, 1988). Wu et al. (2007) and Zollo et al. (2002) state that organizations can usually acquire external knowledge and partner-specific experience that are complementary so as to increase their innovation performance. Besides the advantages related to effective complementary knowledge transfer, other direct effects of external social capital on (financial and nonfinancial) innovation success should be highlighted: enhancing the speed of new product development (De Man and Duysters, 2005; Rindfleisch and Moorman, 2001), and building an advantage in quickly establishing a new technology, thereby augmenting the penetration and establishment of new standards (Schilling, 1998). We expect that the most successful innovative companies will be involved in better interorganizational relationships than the least innovative performers. Thus, summarizing the features of intellectual capital, the most successful innovative firms differ from the least innovative firms in that they have valuable and unique human capital, a large quantity of stored firm information (organizational capital) and strong internal and external relationships based on mutual feelings of attachment and trust (internal and external social capital).

**Knowledge-based view**

Research involving organizational knowledge has emphasized the importance of different dimensions of knowledge. However, there has been little consistency in classifying knowledge. One of the first studies that widely analyzed knowledge dimensions was that of Winter (1987), who states that knowledge is compounded in the following four dimensions. The first one refers to the tacit character or possibility that knowledge can be communicated in a symbolic way from its possessor to another person, in a way in which the recipient finally knows as much as the originator of knowledge. The second dimension is knowledge observability. This dimension covers the possibility of observing knowledge in its use. That is, knowledge observability is the extent to which the necessary underlying knowledge is revealed by its use. The third dimension is knowledge complexity, or the quantity of information necessary to characterize a particular item of knowledge. Lastly, Winter (1987) establishes the systemic dimension as knowledge dependence on a system, or the necessity of combining knowledge with other elements of knowledge to make it useful. Each one of these dimensions is represented in a continuum, in such a way that the knowledge located near the left end of each dimension presents bigger problems for its transfer and imitation than that knowledge located near the right end. This paper considers that all of these dimensions have some effect on innovation success. However, based on more recent studies such as Gopalakrishnan et al. (1999) and Subramaniam and Venkatraman (2001), we have included the observability dimension along with the tacitness dimension. Therefore, we are going to deeply analyze how tacit/explicit, complex/simple and systemic/autonomous knowledge is present in best and/or worse innovative companies.

**Tacit versus explicit knowledge: Why explicit knowledge can be the seed of innovation success?**

Knowledge tacitness is the most common knowledge dimension (Gopalakrishnan et al., 1999; Grant, 1996; Nonaka, 1994; Polanyi, 1966). Polanyi (1966) classifies human knowledge in two categories. On the one hand, Polanyi (1966) distinguishes explicit or codified knowledge, which is the knowledge that can be transferred through a formal language. That is, it is the knowledge that can be transmitted without the loss of its integrity if the transmitter and receiver share the syntactic rules necessary for its decipherment (Kogut and Zander, 1992). On the other hand, he defines tacit knowledge as having a personal quality that makes its formalization and communication difficult (Nonaka, 1994). Explicit knowledge is expressed verbally or in writing, while tacit knowledge is not verbalized or may even be non-verbalizable, intuitive and not articulable (Hedlund, 1994). Explicit knowledge is easy to process, while tacit knowledge is difficult to articulate and to transmit in a systematic and logical form (Gopalakrishnan et al., 1999). To disseminate tacit knowledge among the members of an organization, it is necessary to transform it into words or numbers that all will understand. It is in fact during the conversion from tacit to explicit knowledge that new knowledge is created (Nonaka and Takeuchi, 1995). Therefore, we agree with some theoretical studies that consider that tacit knowledge is the seed of innovation (Nonaka, 1994). However, when the innovation is fully developed, such tacit knowledge would have already been converted into explicit knowledge (Pérez-Luño, 2009). There are three reasons for such a statement. Firstly, tacit knowledge is personal and cannot be communicated. Secondly, product or service innovations, by definition, need to be observable and based on codified knowledge. Thirdly, innovations require firms to assimilate
customers’ needs into the design and production of the product or service, and the changes must be clearly observable to the customers (Gopalakrishnan et al., 1999). Therefore, in order to obtain successful innovations, organizations need to have been able to convert the personal tacit knowledge into explicit knowledge and/or organizational capital.

Complex versus simple knowledge: How can complex knowledge create successful innovations?

Pringle (1951) defines knowledge complexity as the number of parameters needed to define a system. This way, the quantity of information required to transfer a piece of complex knowledge is very high. The more complex the knowledge is, the higher the number of abilities, routines, technologies and interdependent resources related with this knowledge (Zander and Kogut, 1995). Therefore, the complexity increases the quantity of information necessary for an effective transfer (Gopalakrishnan et al., 1999; Kogut and Zander, 1992; Subramaniam and Venkatraman, 2001; Zander and Kogut, 1995). Simple knowledge, on the other side, may be easily obtained from an outside source and, typically, the cost of developing such knowledge is unjustifiable if it is available elsewhere (Gopalakrishnan and Bierly, 2001). Complex knowledge is required for most production processes and there is a positive relation between knowledge complexity and innovation success. There are a couple of reasons for such statements. First, Gopalakrishnan and Damania (1994) define the complexity of an innovation using three characteristics: its difficulty, its intellectual sophistication, and its originality. Pelz (1985) also associates knowledge complexity with originality. Therefore, to develop successful innovations (something novel), companies need to use some degree of original-complex (or less simple) knowledge. Second, the internal development of innovations based on complex knowledge familiarizes the organization’s personnel with the difficult and original elements of the innovation (Kogut and Zander, 1992), and consequently reduces imitation risk and allows firm to appropriate the innovation rents. Then, we expect that the most successful innovative companies will have more complex knowledge than the least innovative ones.

Systemic versus autonomous knowledge: Why successful innovations are based on systemic knowledge?

It has been mentioned that the dependent (systemic) or independent (autonomous) character of knowledge refers to the necessity or not of combining knowledge with other elements so that it is of use (Winter, 1987). This way, independent or autonomous knowledge can be used without the necessity of being combined with previous knowledge, while the dependent or systemic knowledge requires this combination to be useful (Gopalakrishnan et al., 1999; Winter, 1987). In this sense, an innovation could be viewed as autonomous if it can be developed and implemented as a black box and plugged into related components or processes (Gopalakrishnan et al., 1999). However, we consider that to develop successful innovations, the organizational knowledge used in the innovation process should be dependent or systemic. That is, the innovation process requires the organization to combine its existing knowledge with new knowledge. Thus, we expect that the knowledge will be more systemic in the most successful innovative companies than in the least successful ones.

Thus, summarizing knowledge features, the most successful innovative firms differ from the least innovative firms in that they have knowledge that is more explicit, more complex and more systemic.

Why is knowledge exchange and combination important for innovation?

The ability to create new knowledge enables firms to both innovate and to outperform their rivals, that is, it is related to innovation success (Grant, 1996; Kogut and Zander, 1992). Collins and Smith (2006) state that such ability results from the collective ability of employees to exchange and combine knowledge (Nahapiet and Ghoshal, 1998). That is, the knowledge possessed by individuals must be transferred to the group level and the organization as a whole so that it can be applied, giving rise to innovations (Nonaka and Takeuchi, 1995).

The relevance of knowledge exchange and combination for innovation has been theoretically argued in several studies. Cohen and Levinthal (1990) consider that the interaction between individuals who possess different knowledge improves the organization’s ability to innovate. Thus, Seidler-de Alwis and Hartmann (2008) find that organizations that promote knowledge sharing processes are more successful in innovation. Collins and Smith (2006) found that, knowledge sharing was a great indicator of firm performance (understanding firm performance as the revenue from new products and services). Therefore, we expect that the most successful innovative companies will achieve higher degrees of knowledge exchange and combination than the least successful performers.

Radicalness of Innovation

The concept of radicalness has been defined broadly as the magnitude of change or degree of novelty of the innovation (Gatignon et al., 2002; Tidd et al., 1999). Radicalness will be analyzed here at a macro level, that is, with regard to the world, the market or the industry in
which the company operates (Garcia and Calantone, 2002; Johannessen et al., 2001). At a macro level, a distinction has usually been made between two dimensions: Technology and market (Gatignon et al., 2002; Gatignon and Xuereb, 1997; OECD/Eurostat, 1997; De Brentani, 2001; Chandy and Tellis, 1998, 2000).

The technological dimension of radicalness determines the extent to which the technology involved in a new product is different from prior technologies (Chandy and Tellis, 1998) or whether a new product incorporates a substantially different core technology (Chandy and Tellis, 2000).

The market dimension has two different meanings in the literature. One, it is defined as uniqueness/new customer benefits, that is, in terms of the extent to which the new product fulfills key customer needs better than existing products (Chandy and Tellis, 1998) or provides substantially higher customer benefits (Chandy and Tellis, 2000); but on the other hand, it is defined as newness to customers in the sense of customer unfamiliarity (Kock, 2007) or as “the degree to which the new product/service varies from current customer consumption requirements and experiences, and thus the degree of learning and adoption effort required by customers” (Atuahene-Gima, 1996a). It also refers to the time or difficulty in understanding the new product/service concept or its advantages (Avlonitis and Salavou, 2007). The three different meanings of radicalness are likely to relate differently to the best and worst innovative performers. Uniqueness or new customer benefits, associated with relative advantage and differentiation, are expected to be higher for the most successful innovative companies (Atuahene-Gima, 1996a, 1996b; Calantone et al., 2006; Kock, 2007; Song et al., 2010; Kim and Atuahene-Gima, 2010). Newness to customers, linked to customer change, uncertainty and risk, is probably higher for the least successful innovative companies (Atuahene-Gima, 1996b; Calantone et al., 2006; Kock, 2007).

Some authors argue that radical innovations (Chandy and Tellis, 1998; Sorescu, Chandy, and Prabhu, 2003) or technology-based breakthrough innovations (Zhou et al., 1998; Sorescu, Chandy, and Prabhu, 2003) or whether a new product incorporates a substantially different core technology (Chandy and Tellis, 2000).

The process of knowledge and the degree and dimensions of innovation radicalness, which differentiate them from the least successful ones. Table 1 provides a summary of the previous statements.

In addition to the main variables analyzed in this study related to innovation success, intellectual capital, knowledge and radicalness, we also included firm performance to confirm that innovation success leads to positive consequences or results for the company as shown by previous research (Paladino, 2007). Other firm variables such as size, age and industry will also be examined.

MATERIALS AND METHODS

Sample and data collection

The companies that have been chosen for the study belong to manufacturing industries: Mechanical machinery and equipment, and service industries: Software or computer programming services, and research and development services. These industries have a relatively high percentage of innovative companies (that is, companies developing a successful product or process innovation in the 2003–2005 period), according to the latest available Technological Innovation in Companies Survey from Spain (INE, 2007). Companies have to carry out new product development or improvements of existing products, and have at least 50 employees in the cases of both the manufacturing industry and software or computer programming services, and at least 20 in the case of research and development services (because of its relatively small size). The study population is composed of 537 companies (extracted from the SABI, a database that contains financial information of Spanish and Portuguese companies), which met all these requirements.

Data collection was conducted via survey. R&D managers responded to questions about intellectual capital and knowledge and both R&D managers and marketing managers were invited to respond to questions about innovation success, radicalness and firm performance. In this way, we reduced the potential common-method variance bias. In some firms, we only received responses from one or two managers. This could be explained in part because some companies were relatively small and only one person occupied these positions. Previous research has also utilized from three to one respondent by firm (Ramani and Kumar, 2008). Data were collected during 2008.

One hundred and eighty-one responses were received, which provided a response rate of 33.7%. Table 2 gives information about the companies included in the sample. A chi-squared test applied to a contingency table with both the companies included and not included in the sample and the industry categories (manufacturing and services) is not statistically significant ($\chi^2(1) = 1.744, p > 0.05$). The t-test of equality of means for independent samples shows that the difference in the mean score is not statistically significant between both groups of companies regarding the number of employees ($t_{(155)} = .392, p > 0.05$) and age ($t_{(155)} = -.462, p > 0.05$). Therefore, it seems that there is not a problem of nonresponse bias in our data because of industry, company size and age.

Measures

Most of the measures have been adapted from measurement scales used and validated by previous research. We asked about
Table 1. Characteristics of best innovative companies.

1. Valuable and unique human capital
2. High level of organizational capital
3. High level of internal and external social capital
4. Explicit, complex and systemic knowledge
5. High level of knowledge exchange and combination
6. High technological radical innovations, high new customer benefits and low newness to customers

Table 2. Sample of companies.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number of companies</th>
<th>Proportion (%)</th>
</tr>
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<tbody>
<tr>
<td><strong>Industry</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>97</td>
<td>53.6</td>
</tr>
<tr>
<td>Services</td>
<td>84</td>
<td>46.4</td>
</tr>
<tr>
<td><strong>Number of employees (size)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Up to 49</td>
<td>20</td>
<td>11.0</td>
</tr>
<tr>
<td>50–99</td>
<td>77</td>
<td>42.5</td>
</tr>
<tr>
<td>100–249</td>
<td>56</td>
<td>30.9</td>
</tr>
<tr>
<td>250–499</td>
<td>20</td>
<td>11.0</td>
</tr>
<tr>
<td>500 or more</td>
<td>8</td>
<td>4.4</td>
</tr>
<tr>
<td><strong>Age (years)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 or younger</td>
<td>42</td>
<td>23.2</td>
</tr>
<tr>
<td>11–20</td>
<td>50</td>
<td>27.6</td>
</tr>
<tr>
<td>21–30</td>
<td>42</td>
<td>23.2</td>
</tr>
<tr>
<td>Over 30</td>
<td>47</td>
<td>26.0</td>
</tr>
<tr>
<td>Total</td>
<td>181</td>
<td>100.0</td>
</tr>
</tbody>
</table>

new or significantly improved products/services introduced by the company in the previous five years to measure innovation success and radicalness. Intellectual capital and knowledge are measured within the R and D department. Table 3 shows the measures used in our study.

Within-firm agreements between managers were assessed by the interrater agreement measure, \( r_{ag} \), developed by James et al. (1984, 1993). This indicator ranges from 0 (complete disagreement) to 1 (complete agreement). In general, the median \( r_{ag} \) values obtained suggest an acceptable degree of agreement or consistency between the respondents (Chen et al., 2008). Therefore, we averaged the scale items from multiple respondents to form single ratings for each construct and company.

Given that the measurement scales used were based upon an exhaustive review of the relevant literature concerning the constructs under study, we can initially affirm its content validity. An exploratory factor analysis was performed separately for each dimension or construct, and those factors with eigenvalues greater than 1 were selected. All the items in each dimension or construct loaded in one factor (unidimensionality). However, in the technological dimension of radicalness, the item R-T1 had a low and negative factor loading, in newness to customers the item R-NC4 also had a low factor loading, and in systemic knowledge the item SYS1 loaded in another factor. All the three items were deleted. With regard to reliability, Cronbach’s alpha exceeded the minimum value of 0.7 recommended by Nunnally and Bernstein (1995) for all the measures (Table 3). Thus, these measures seem to be reliable and valid. Number of employees (firm size), age and industry are objective data obtained from the SABI database.

Analysis

Best practices studies methodology comparing best and worst performers has the advantage of providing an overall view of how companies differ in terms of a large number of variables (Cooper et al., 2004).

Two groups of firms were created based on their scores of innovation success, for both financial and non-financial performance dimensions. The least successful innovative companies are below the 35th percentile and the most successful are above the 65th percentile in both dimensions of innovation success separately. For the financial performance dimension of innovation success, there are 63 firms in the best group and 71 firms in the worst group. For the nonfinancial dimension, there are 72 best and 83 worst innovative companies. One-factor ANOVA will test for the existence of statistically significant differences in the scores of the variables analyzed between best and worst performers.

The number of companies in each group can vary depending on the analyzed variable because of missing data.
### Table 3. Measurement scales.

**Innovation success (at the firm level)**
(adapted from Avlonitis et al. (2001) new service performance scale)

Regarding the new or significantly improved products/services introduced by the company in the previous five years:

**Financial performance dimension \((\alpha = .922)\)**

- IS-FP1: They were profitable.
- IS-FP2: Their total sales were high.
- IS-FP3: They had a large market share.
- IS-FP4: They exceeded their profit objectives.
- IS-FP5: They exceeded their sales objectives.
- IS-FP6: They exceeded their market share objectives.

**Nonfinancial performance dimension \((\alpha = .846)\)**

- IS-NFP1: They had a positive impact on the company’s perceived image.
- IS-NFP2: They improved the loyalty of the company’s existing customers.
- IS-NFP3: Their introduction enhanced the profitability of other company products.
- IS-NFP4: They attracted a significant number of new customers to the company.
- IS-NFP5: They gave an important competitive advantage to the company.

**Intellectual capital (within the R and D department)**

**Human Capital \((\alpha = .901)\)**
(adapted from Subramaniam and Youndt’s (2005) scale)

Regarding the employees of the R and D department:

- HC1: They are highly skilled.
- HC2: They are widely considered the best in our industry.
- HC3: They are creative and bright.
- HC4: They are experts in their particular jobs and functions.
- HC5: They develop new ideas and knowledge.

**Organizational capital \((\alpha = .759)\)**
(adapted from Subramaniam and Youndt’s (2005) scale)

Regarding the R and D department:

- OC1: It uses patents and licenses as a way to store knowledge.
- OC2: Much of its knowledge is contained in manuals, databases, etc.
- OC3: Culture (stories, rituals) contains valuable ideas, ways of doing business, etc.
- OC4: It embeds much of its knowledge and information in structures, systems, and processes.

**Internal social capital \((\alpha = .941)\)**
(adapted from Merlo et al.’s (2006) scale)

- ISC1: Overall, the intentions of those in my department are good.
- ISC2: Members of my department are always honest and trustworthy.
- ISC3: Members of my department exhibit a great deal of integrity.
- ISC4: I fully trust members of my department.

**External social capital \((\alpha = .865)\)**
(based on article by Maurer and Ebers (2006))

- ESC1: Overall, a climate of cooperation and trust exists in our agreements with other companies for the development of new products and the improvement of existing products.
- ESC2: Companies with which we collaborate exhibit a high degree of commitment to our projects.

**Knowledge (within the R and D department)**

Regarding the knowledge that incorporates new or significantly improved products/services introduced by the company in the previous five years:
Table 3 Contd.

Tacit Knowledge ($\alpha = .805$)
(based on articles by Hansen et al. (1999), Subramaniam and Venkatraman (2001) and Norman (2002))
TAC1: It is easy to comprehensively document in manuals and report (reversed).
TAC2: It can be precisely communicated through written documents (reversed).
TAC3: It is easy to comprehensively understand from written documents (reversed).
TAC4: It is obvious to all competitors (reversed).
TAC5: It is easy to identify without personal experience in the area (reversed).

Complexity ($\alpha = .866$)
(based on articles by Winter (1987), Subramaniam and Venkatraman (2001) and Gopalakrishnan, Bierly and Kessler (1999))
COM1: It requires prior learning in other technologies and related knowledge.
COM2: It requires a large quantity of information.
COM3: It is technologically sophisticated and difficult to implement.
COM4: It is complex (vs. simple).

Systemic knowledge ($\alpha = .789$)
(adapted from Gopalakrishnan, Bierly and Kessler's (1999) systemic versus autonomous scale)
SYS1: It is independent of other products and services offered by the organization (reversed).
SYS2: Its users need to be in contact with other departments within the organization.
SYS3: Its implementation requires knowledge about other systems within the organization.

Knowledge exchange and combination ($\alpha = .945$)
(adapted from Collins and Smith's (2006) scale)
Regarding the employees of the R and D department:
KEC1: They see benefits from exchanging and combining ideas with one another.
KEC2: They believe that by exchanging and combining ideas they can move new projects or initiatives forward more quickly than by working alone.
KEC3: At the end of each day, they feel that they have learned from each other by exchanging and combining ideas.
KEC4: They are proficient at combining and exchanging ideas to solve problems or create opportunities.
KEC5: They are capable of sharing their expertise to bring new projects or initiatives to fruition.
KEC6: They are willing to exchange and combine ideas with their co-workers.

Radicalness (at a macro level)
Technological dimension ($\alpha = .896$)
(adapted from Gatignon et al.'s (2002) radicalness scale)
Regarding the new or significantly improved products/services introduced by the company in the previous five years:
R-T1: They represented a minor improvement over the previous technology (reversed).
R-T2: They were based on a revolutionary change in technology.
R-T3: They were a breakthrough innovation.
R-T4: They led to products that were difficult to replace with substitutes using older technology.
R-T5: They represented a major technological advance in the subsystems.

Uniqueness/New customer benefits ($\alpha = .856$)
(adapted from Avlonitis and Salavou’s (2007) new product uniqueness scale)
R-U/NCB1: They offer more possibilities to customers.
R-U/NCB2: They offer unique, innovative features to customers.
R-U/NCB3: They cover more customer needs.
R-U/NCB4: They have more uses.
R-U/NCB5: They are of higher quality.
R-U/NCB6: They are superior in technology.
Table 3 Contd.

**Newness to customers** (α = .845)
(adapted from Avlonitis and Salavou’s (2007) product newness to customer scale)

R-NC1: They required a major learning effort by customers.
R-NC2: It took a long time before customers could understand its full advantages.
R-NC3: The product/service concept was difficult for customers to understand.
R-NC4: They were not known and tried in the market.

**Firm performance** (α = .930)
(adapted from Zahra’s (1996) firm performance index: Satisfaction with the company’s achievement of six goals, weighted by its perceived importance)

FP1: Return on investment.
FP2: Return on equity.
FP3: Sales growth.
FP4: Net profit margin.
FP5: Market share.
FP6: Return on assets.

**Other variables**
Firm Size (number of employees)
Age (2008 - company foundation date)
Industry (manufacturing versus services)

All the measures use a seven-point scale, with the exception of firm performance, which ranges from 1 - 49 and control variables. *Eliminated in an exploratory factor analysis.

RESULTS

Means, standard deviations, and one-factor ANOVA for the groups of best and worst innovative companies according to levels of innovation success, intellectual capital, knowledge, radicalness and firm performance, are shown in Table 4 for the financial dimension of innovation success and in Table 5 for its nonfinancial dimension.

First, we checked that there are statistically significant differences between the best and the worst performers in terms of innovation success. One-factor ANOVA showed for both the financial (Table 4) and the non-financial (Table 5) dimensions that the best groups had a higher mean score than the worst group of innovative firms (P<0.001).

All the dimensions of intellectual capital: Human capital, organizational capital, and internal and external social capital had statistically significant higher means scores for the best than for the worst innovation performers, considering either the financial (Table 4) or the nonfinancial (Table 5) dimensions of innovation success.

Regarding knowledge, when the financial dimension of innovation success was analyzed (Table 4), tacit knowledge and complexity were lower for the best performers than for the worst performers. Knowledge exchange and combination mean score was greater for the best performers than for the worst performers, and there were not statistically significant differences for systemic knowledge. By contrast, in the non-financial dimension of innovation success (Table 5), only knowledge exchange and combination showed a statistically significant difference between both groups of companies, being higher for the most successful innovative companies than for the least ones.

In the case of radicalness of the innovation, the means scores for its technological dimension and for uniqueness/new customer benefits were significantly higher for the best than for the worst performers, considering both financial (Table 4) and non-financial (Table 5) performance dimensions of innovation success. The mean of newness to customer was greater for the least successful innovative companies than for the most successful ones for the financial performance dimension of innovation success. Nonstatistically significant differences were observed for its nonfinancial performance dimension.

Finally, the most successful innovative companies had a greater firm performance mean than the least successful ones, using both the financial (Table 4) and nonfinancial (Table 5) dimensions of innovation success. There was not a statistically significant difference between the two groups of companies with regard to firm size (for both the financial and the nonfinancial dimensions), with
Table 4. One-factor ANOVA on the financial performance dimension of innovation success.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>F-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial performance dimension</td>
<td>Worst</td>
<td>63</td>
<td>3.8113</td>
<td>0.56864</td>
<td>358.896***</td>
</tr>
<tr>
<td></td>
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<td>0.45226</td>
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</tr>
<tr>
<td>Human capital</td>
<td>Worst</td>
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<td>5.2704</td>
<td>0.89688</td>
<td>3.483†</td>
</tr>
<tr>
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<td>0.74503</td>
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</tr>
<tr>
<td>Organizational capital</td>
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<td>4.7199</td>
<td>1.11141</td>
<td>4.103*</td>
</tr>
<tr>
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<td>5.1379</td>
<td>1.07240</td>
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</tr>
<tr>
<td>Internal social capital</td>
<td>Worst</td>
<td>54</td>
<td>5.7870</td>
<td>0.99457</td>
<td>3.312†</td>
</tr>
<tr>
<td></td>
<td>Best</td>
<td>58</td>
<td>6.0905</td>
<td>0.76225</td>
<td></td>
</tr>
<tr>
<td>External social capital</td>
<td>Worst</td>
<td>52</td>
<td>4.8245</td>
<td>1.14491</td>
<td>5.487**</td>
</tr>
<tr>
<td></td>
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<td>57</td>
<td>5.3070</td>
<td>1.00531</td>
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<tr>
<td>Tacit knowledge</td>
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<td>56</td>
<td>3.5089</td>
<td>0.95371</td>
<td>8.505**</td>
</tr>
<tr>
<td></td>
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<td>3.0583</td>
<td>0.69874</td>
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</tr>
<tr>
<td>Complexity</td>
<td>Worst</td>
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<td>4.4576</td>
<td>1.05509</td>
<td>9.178**</td>
</tr>
<tr>
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<td>3.8097</td>
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<td></td>
</tr>
<tr>
<td>Systemic knowledge</td>
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<td>4.2500</td>
<td>1.30993</td>
<td>0.959</td>
</tr>
<tr>
<td></td>
<td>Best</td>
<td>60</td>
<td>4.0167</td>
<td>1.25623</td>
<td></td>
</tr>
<tr>
<td>Knowledge exchange and combination</td>
<td>Worst</td>
<td>54</td>
<td>5.3256</td>
<td>0.92913</td>
<td>4.498*</td>
</tr>
<tr>
<td></td>
<td>Best</td>
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<td>5.6740</td>
<td>0.79950</td>
<td></td>
</tr>
<tr>
<td>Technological dimension</td>
<td>Worst</td>
<td>63</td>
<td>4.5159</td>
<td>1.18572</td>
<td>5.208*</td>
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<tr>
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<td>Best</td>
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<td>4.9354</td>
<td>0.93930</td>
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<tr>
<td>Uniqueness/New customer benefits</td>
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<td>63</td>
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<td>0.87085</td>
<td>2.848†</td>
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<tr>
<td></td>
<td>Best</td>
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<td>5.4117</td>
<td>0.75274</td>
<td></td>
</tr>
<tr>
<td>Newness to customers</td>
<td>Worst</td>
<td>63</td>
<td>3.7831</td>
<td>0.99590</td>
<td>8.077**</td>
</tr>
<tr>
<td></td>
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<td>3.2473</td>
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</tr>
<tr>
<td>Firm performance</td>
<td>Worst</td>
<td>62</td>
<td>22.6871</td>
<td>8.42694</td>
<td>25.979***</td>
</tr>
<tr>
<td></td>
<td>Best</td>
<td>68</td>
<td>29.5923</td>
<td>7.00463</td>
<td></td>
</tr>
<tr>
<td>Firm size</td>
<td>Worst</td>
<td>63</td>
<td>164.98</td>
<td>256.710</td>
<td>0.944</td>
</tr>
<tr>
<td></td>
<td>Best</td>
<td>71</td>
<td>273.34</td>
<td>851.239</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>Worst</td>
<td>63</td>
<td>21.87</td>
<td>14.983</td>
<td>0.493</td>
</tr>
<tr>
<td></td>
<td>Best</td>
<td>71</td>
<td>20.11</td>
<td>14.020</td>
<td></td>
</tr>
</tbody>
</table>

regard to age for the financial dimension, and with regard to industry (financial dimension: $\chi^2_{(1)} = 1.017, P>0.05$; nonfinancial dimension: $\chi^2_{(1)} = 2.682, P>0.05$). However, for the nonfinancial dimension of innovation success,
Table 5. One-factor ANOVA on the nonfinancial performance dimension of innovation success.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>F-statistic</th>
</tr>
</thead>
<tbody>
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<td>Non-Financial performance dimension</td>
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<tr>
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<tr>
<td>Human capital</td>
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<td>0.8699</td>
<td>10.320**</td>
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<tr>
<td></td>
<td>Best</td>
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<td>0.9959</td>
<td>7.342**</td>
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<td>0.8853</td>
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<tr>
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<td>5.8076</td>
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<td>Uniqueness/New customer benefits</td>
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<td>.329</td>
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<tr>
<td></td>
<td>Best</td>
<td>83</td>
<td>217.45</td>
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<tr>
<td>Age</td>
<td>Worst</td>
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<td>15.99</td>
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<tr>
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<td>Best</td>
<td>83</td>
<td>19.75</td>
<td>14.48</td>
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</table>

Younger firms were better performers than older firms.

DISCUSSION

This paper discussed the different features that characterize the best and worst innovative companies, focusing on several aspects related to the way in which these companies manage their knowledge and the radicalness of the innovations they develop. Three separate bodies of literature (the intellectual capital, knowledge-based view and innovation literatures) have been
brought together in our research as a promising approach, which suggests convincing theoretical explanations for our proposals. Our research provided interesting findings regarding the topics discussed: intellectual capital (human, organizational and social capital), knowledge-based view and innovation radicalness.

Regarding the elements of intellectual capital, successful innovative companies have shown high levels of human capital. That is, their employees are highly skilled, creative, and willing to develop new ideas and knowledge (value of human capital). Furthermore, these individuals, experts in their particular jobs and functions, are irreplaceable and idiosyncratic, and their specialized knowledge allows the company to generate a competitive differentiation (uniqueness of human capital). Although we have focused our intellectual capital analysis on R and D and innovation departments of innovative companies, and one could suppose that human capital is a strategic resource for all of them, there are clear differences in the degrees of capabilities, creativity, experience, development of new ideas and knowledge and so on between the best and worst innovative companies.

Regarding organizational capital, institutionalized knowledge stored in the form of standard operating procedures, routines and scripts, is present in the most successful innovative companies to a greater extent than in less innovative ones. Thus, the best performers successfully manage the process through which valuable knowledge is institutionalized and the memory of the organization is built. This process of codification and storing of knowledge allows these companies to systematically transmit and disseminate it in ways that people involved in innovation activities can use it in other new projects.

Internal social capital, that is, a high level of quality of the relationships between individuals involved in innovative activities, also seems to be a feature of the best performers. Although organizational capital was revealed to be a valuable means of knowledge sharing, relationships between individuals add irreplaceable benefits for knowledge transmission. Sveiby (1997) stated that, “many managers tend to believe that a word written is a word understood. They forget that the receiver of information, not the giver, gives it meaning.” In this sense, this work provides empirical evidence that high-quality relationships between individuals within a firm contribute to its ability to create value in the form of successful innovations. The proximity, familiarity, trust and respect inherent in these relationships make people more willing to engage in knowledge exchange and cooperative interactions in their innovation activities. Similarly, the strength of the interorganizational relationships (external social capital) is also more present in the most successful innovative companies. As we had argued, when companies are involved in interorganizational agreements characterized by a high level of trust, the transfer of knowledge is improved, knowledge is more meaningfully understood and more effectively exchanged, combined and utilized, and firms are more willing to spend more time and financial resources on innovative activity, all of which may positively influence the success of innovation agreements.

Regarding knowledge, as expected, we have found that knowledge exchange and combination is a characteristic of the most successful innovators (using both the financial and nonfinancial indicators). This is important because previous literature already states that the ability to create new knowledge enables firms to both innovate and to outperform their rivals (Grant, 1996; Kogut and Zander, 1992). Our study went further by explaining that the collective ability of employees to exchange and combine knowledge is really the base of innovation success.

On the side of knowledge dimensions, we have obtained interesting findings. Consistent with our previous statements, we found higher levels of explicit knowledge (versus tacit) in successful innovators, but only in the financial dimension of innovation success. If fact, one could argue that items for explicit knowledge are closed to organizational capital (as codifiability is used as equivalent to explicit knowledge). Therefore, it makes sense to obtain similar results when analyzing less tacit knowledge and higher organizational capital. That is, our results for the financial dimension of successful innovators are consistent along two different but related bodies of research: the knowledge based view and the intellectual capital. However, other findings regarding the noncomplex knowledge within financial successful innovation firms, and no differences at all in any dimension in the type of knowledge (tacit-explicit, complex-simple, systemic-autonomous) within nonfinancial successful innovation firms, require further discussion. That is, we have found that best and worse innovative companies differ in both intellectual capital (taking into account all of the studied dimensions) and knowledge exchange and combination. However, the type of knowledge is not really useful to discriminate between both types of firms. In this sense, arguments as those proposed by Cohen and Levinthal (1990) and Kim and Atuahene-Gima (2010), where the key for obtaining competitive advantages is the process of absorptive capacity and/or learning (and not the type of knowledge absorbed or learned), could explain our findings.

Regarding innovation radicalness, we observed that firms with more innovation success provide uniqueness or new customer benefits, while firms with less innovation success are those which launch new products or services that are unfamiliar or difficult to understand by customers. This is consistent with the framework of Rogers (1995), in which the relative advantage of an innovation is positively
related to its rate of adoption, and its complexity is negatively related. It is also congruent with the Technology Acceptance Model (TAM) by Davis (1989), where perceived usefulness and perceived ease-of-use are determinants of intention to use a new technology. Companies should develop products or services with clear advantages in comparison with competitors and reduce the learning effort required by customers. The technological radicalness is greater for the best than for the worst performers, showing that investing in R and D to develop new technologies translates into superior innovation success.

Finally, we found that companies with greater innovation success have also greater firm performance. This finding demonstrates that the more innovative the company, the more profitable it is.

Our research suggests interesting practical implications. It seems that managers should pay attention to all the dimensions of a firm’s intellectual capital. Having a human capital with high levels of capabilities, creativity and experience appears critical in becoming an outperforming innovative firm. Similarly, R and D managers should design systems by which knowledge is codified, documented and stored in such a way that people have easy access to it. Furthermore, improving the quality of relationships between people should be a concern for managers. Encouraging techniques specifically designed to promote trustworthy collaborations not only within the firm but with other firms/institutions seems to foster innovation success. In general, managers should keep in mind that knowledge sharing and combination are characteristics of the most successful innovators, who usually develop more radical innovations in the sense that they provide uniqueness or new customer benefits.

This research has some limitations. First, the sample of companies was small and belongs to only three Spanish industries. Therefore, there is no guarantee that the results obtained can be generalized to other sectors. Second, regarding intellectual capital, we focus on the relational side of social capital, and cognitive and structural sides are not analyzed, which needs to be addressed in future research. Third, the use of cross-sectional data showed us the differences between best and worst innovative companies at a moment in time. Longitudinal studies would be necessary to clarify whether our results change over time. Finally, although it was beyond the scope of this study, future research should analyze how firms can take advantage of their knowledge to transform their innovations into intellectual assets. This issue has been demonstrated to be critical in guaranteeing the rights of ownership, and ultimately the firms’ benefits appropriation.

Summarizing, as conclusions of this research, we highlight the relevance of the three sides of intellectual capital (human, social and organizational) for innovation success. Also, the processes of knowledge exchange and combination are more determinants for innovation success than the type of knowledge. Companies which develop radical innovations also achieve a higher level of success. Finally, firm performance is associated with innovation success.

ACKNOWLEDGEMENT

This research has been supported by the Spanish Ministry of Innovation and Science (Research Project ECO2010-21859).

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