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DO BEST AND WORST INNOVATIVE COMPANIES DIFFER IN TERMS OF INTELLECTUAL CAPITAL, KNOWLEDGE AND RADICALNESS?

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Abstract

This paper differentiates "best innovative companies" from "worst innovative companies" and it takes into account three separate bodies of literature— intellectual capital, knowledge-based view, and innovation literatures. Based on a sample of 181 firms which belong to manufacturing and services industries, our findings show that best innovative performers companies (considering both financial and non-financial dimensions of innovation success) present systematically higher scores for all dimensions of intellectual capital: human, organizational and social capital) than worst innovation performers. Knowledge exchange and combination seems to be characteristic of most successful innovators, but no differences in systemic, tacit, complex and not observable knowledge have been found for these companies. Finally, regarding radicalness, firms with more innovation success provide new products or services that incorporates a new technology and new customer benefits (uniqueness), while firms with less innovation success laughs new products or services which are unfamiliar or difficult to understand by customers.

Keywords: Best and worst innovative companies, intellectual capital, knowledge, radicalness

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1. INTRODUCTION

Looking for the features which explain the differences between the most and the least successful innovative companies has been a challenging concern for both academics and practitioners. In this sense, the identification of a set of best practices has represented a traditional approach to tackle this issue. Best practices, which have been defined as a tactic or method that has been shown through real-life implementation to be successful (Dooley, Subra and Anderson, 2002), have been studied from several approaches. One of the most extensive researches in this field has been the Product Development and Management Association (PDMA) survey on NPD (Griffins, 1997) which tries to determine which practices are more commonly associated with firms that are more successful in developing new products. Dooley et al. (2002) analyzed 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, Edgett and Kleinschmidt (2004) also report about the results of the American Productivity and Quality Center study on performance and best practices in new product development. They highlighted a set of best practices organized in 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. In all these researches, one could miss some reference to the way and mechanisms that successful companies use to manage the knowledge in their innovation activities. Although other researchers 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 that has been shown through real-life implementation to be successful (Dooley, Subra and Anderson, 2002).

Beyond the search of a set the specific best practices for innovation success, our approach tries to progress in the understanding of the differential features that characterize the most successful companies in its innovation activities, focusing on several aspects related with 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, provided by Subramaniam and Youndt (2005), who consider three aspects of intellectual capital: 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. 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, Nohria, and Tierney 1999). Third, social capital can be defined as resources generated by interpersonal networks which are, therefore, embedded and available within those resources (Nahapiet and Ghoshal 1998). Social capital affects information and its 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 among

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 do not consider the types and processes of knowledge that is embedded in the innovation activities. That is, given that the ability to create new knowledge enables firms to both innovate and to outperform their rivals (Grant, 1996b; Kogut and Zander, 1992), we are going to analyze the types of knowledge (systemic vs. autonomous; tacit vs. explicit; complex vs. simple; and observable vs. nonobservable) and knowledge exchange and combination that lead to more susccessful innovations.

Finally, innovativeness or radicalness of innovation, which is a result of the application of new knowledge, is one of the characteristics of new products or services that can also affects innovation success (Szymanzki, Kroff and Troy, 2007).

Based on the previous arguments, the main objective of this research is to identify the features which differentiate the most successful innovative companies from the least ones, regarding to three relevant topics in the field of innovation research, which are intellectual capital, knowledge and radicalness.

Our criteria to identify the best and the worst innovative companies (in order to determine their specific features) is innovation success (or new product or innovation performance), which has been usually considered as commercial success, in terms of sales, profitability or market share from new products (Kleinschmidt and Cooper, 1991; Montoya-Weiss and Calantone, 1994; Gatignon and Xuereb, 1997; Langerak, Hultink and Robben, 2004; Calantone, Chan and Cui, 2006; Paladino, 2007; Szymanski, Kroff and Troy, 2007; Kock, 2007). All of these variables are

indicators of the financial dimension of the innovation performance, however, few studies capture the non financial performance of innovation, which also represent positive consequences to the firm: company image, retention of existing customers, attraction of new customers, profitability of other company products, competitive advantage, etc. (Avlonitis, Papastathopoulou and Gounaris, 2001; Salavou and Avlonitis, 2008).

This paper makes several contributions to research. First, our research contributes to the literature examining both the financial and non-financial performance dimensions of innovation success (Avlonitis, Papastathopoulou and Gounaris, 2001) at the firm level, that is, for the firm's new product portfolio. Second, we study knowledge creation through its main dimensions, which has been scarcely researched in the previous literature, in "best innovative companies". More specifically we analyze the knowledge exchange and combination that gives rise to different knowledge types and different degrees of radical innovations; and how knowledge is obtained and used in the firm, that is, the intellectual capital of the company. Therefore, we contribute to at least three separate bodies of literature—intellectual capital, the knowledge-based view, and innovation. Third, we focus on a departmental level analysis: R&D departments. Most of these aspects of intellectual capital and knowledge have been previously studied referring to the whole organization (Subramaniam and Youndt, 2005). This fact has precisely been considered by these authors as a limitation in this type of research, as it is difficult to obtain an aggregated measure of intellectual capital. Although it is clear that knowledge could be generated in the whole organization, it is also true that its influence on innovation is especially relevant in these R&D departments. However, we consider the company level for innovation success, radicalness of new products or services and firm performance.

The paper proceeds as follows. The first section presents the conceptual framework that used to differentiate between best and worst innovative companies. The second section describes the empirical analysis that has been conducted. Last, conclusion and discussion includes findings and presents further contributions, limitations and ideas for future research directions.

2. CONCEPTUAL FRAMEWORK: SEPARATING BEST FROM WORST

Three topics have been studied in order to differentiate the most successful companies in its innovative activities: Intellectual Capital, Knowledge and Radicalness.

2.1. Intellectual Capital

As have been stated above, three components of Intellectual Capital can be considered: human capital, organizational capital and social capital. In the paragraphs below we propose how and why these issues are present in the most successful innovative companies.

Human capital: How should be the individuals 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, Valle and Herrero, 2006). Then, we expect that the most innovative companies will present the highest levels of human capital.

Our reasoning must consider the two sides of this individual knowledge. First, its value, as *its potential to improve the efficiency and effectiveness of the firm, exploit market opportunities, and/or neutralize potential threats* (Lepak and Snell 2002, p. 519); second, its uniqueness, as the degree in which an employee is irreplaceable and idiosyncratic, and his or her rare and firm-specific knowledge, skills, and abilities (KSA) (Barney, 1991) are difficult to transfer to other

positions and for other firms to duplicate (Lepak and Snell, 1999; Lengnick-Hall and Lengnick-Hall, 2002).

Companies with a high level of value in its human capital, will have employees who contribute to identifying new market opportunities, who are willing to experiment and apply new procedures and represent the greatest collection and diversity of skills (Costa and McCrae, 1992; Taggar 2002; Subramanian and Youndt, 2005).

Also, companies with a high level of uniqueness, will have employees who generate competitive differentiation, acting as 'rainmakers' and contributing to the development of new ideas and products (James, 2002).

Organizational capital: Is it really important to preserve the knowledge generated within the firm through codification and documentation?

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 taking 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).

Internal Social Capital: How should be the relationships among 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 relationship between people involved in innovation activities will be much better in the most successful innovative companies than in the worst ones.

The importance of the relational dimension of social capital 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).

Besides, 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 the 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). Also Moran (2005) suggests that

although an actor may have access to several people who are potentially critical sources of information for innovation, is the quality of past interactions what 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, 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).

External Social Capital: How should be the relationships with the partners for innovation activities?

Besides internal relationships, firms establish in the course of its business activities a variety of interfirm ties (buyer-supplier relationships, strategic alliances, joint ventures, among others) that enable them to exchange a variety of information and knowledge, overcome the inherent risks associated with the innovation process (Gopalakrishnan, Scillitoe and Santoro, 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, Singh and Perlmutter, 2000; Ring and Van de Ven, 1994) or on the level of social capital embedded in the relationships (Yli-Renko, Autio and Sapienza, 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. We expect that the most

successful innovative companies will be involved in better interorganizational relationships than the least innovative performers.

This idea that strong interfirm linkages, often characterized by long-lasting, repeated and socially dense relationships, favor the innovation success is not new in the managerial arena. This relational embeddedness enhances information utilization and enables firms to proceed more efficiently by lowering 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 among 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, Hurmelinnab and Seppänena, 2005). Besides, highly interconnected (cohesive) network structures promote more intense interactions among 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, Reuer and Singh (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 non-financial) innovation success should be highlighted: enhancing the speed of new product development (Rindfleisch and Moorman, 2001;

Similarly, De Man and Duysters, 2005), building an advantage in quickly establishing a new technology, thereby augmenting the penetration and establishment of new standards (Schilling, 1998).

Thus, summarizing intellectual capital features, we defend that the most successful innovative firms will differ from the least innovative firms in having a high level of human capital, a great amount of stored firm information (organizational capital) and strong internal and external relationships based on mutual fillings of attachment and trust (internal and external social capital).

2.2. How should be the knowledge embedded in the innovative activities?

Research involving organizational knowledge has emphasized the importance of different types of knowledge and has focused on different social entities. However, there has been little consistency in classifying knowledge. One of the first works that widely analyzed knowledge types was that of Winter (1987). This author considers that knowledge is compounded of the following four dimensions. The first dimension 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 receipt finally knows as much as the originator of knowledge. The second dimension analyzed by Winter (1987) is knowledge *observability*. This dimension covers the possibility of observing knowledge in its use. That is, knowledge observability is the extent in 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 incidence in innovation success. For this reason, we will go through to detail them.

Tacit vs. explicit knowledge: Is personal knowledge the seed of innovation success?

In relation to knowledge tacitness, Polanyi (1966) classified human knowledge in two categories. On one hand, he distinguished 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 defined tacit knowledge as the one that has 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 is difficult to articulate and to transmit in a systematic and logical form (Gopalakrishnan and Bierly, 2001). 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 consider that in order to obtain successful innovations, organizations need to use some degree of tacit knowledge.

Knowledge observability: Are successful innovations based on internal developed ideas?

The possibility that knowledge can be observed makes reference to the measure to which the underlying necessary knowledge is revealed by its use (Winter, 1987). That is, knowledge observability establishes the degree in which knowledge can be identified without having personal previous experience, and the degree to which it can be obvious for a generality of users (Subramaniam and Venkatraman, 2001). This dimension depends on the knowledge complexity and codifiability. Non observable knowledge hinders knowledge transfer, aggregation and appropriation. In relation with innovations, it could be affirmed that when knowledge is not observable, companies will have to develop their own ideas to be able to obtain new products. However, if knowledge is observable, all companies could have the same knowledge to launch similar products. Therefore, we expect that the most successful innovative companies will present the lowest knowledge observability.

Complex vs. simple knowledge: How many parameters are needed to create successful innovations?

Pringle (1951) defined 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. This transfer can be carried out, but its cost is usually very high. The more complex the knowledge is, the higher will be 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 (Kogut and Zander, 1992; Zander and Kogut, 1995; Gopalakrishnan, Bierly and Kessler, 1999; Subramaniam and Venkatraman, 2001). Complexity also hinders knowledge aggregation and

appropriation. However, complex knowledge is required for most production processes and needs some specialization in knowledge acquisition. There is an important relation between knowledge complexity and innovation success. Gopalakrishnan and Damanpour (1994) defined the complexity of an innovation using three characteristics: its difficulty, its intellectual sophistication, and its originality. These characteristics suggest that complex knowledge is difficult to understand because it contains advanced technology. Pelz (1985) and Gopalakrishnan and Damanpour (1994) associate knowledge complexity with originality, which means that knowledge will be more difficult to understand if it is associated with uncertainty. Kogut and Zander (1992) found that as technologies became more complex, firms tended to transfer them to its own internal subsidiaries. This implies that complex innovations and technologies will be difficult to transfer outside the company. Information about complex products and technologies often develop over time, as managers absorb new research findings, results of early experiments, and initial customer feedback. The internal development of innovations based on complex knowledge familiarizes the organization's personnel with the difficult and original elements of the innovation and consequently reduces the uncertainty associated with its implementation. However, simple knowledge 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). Then, we expect that the most successful innovative companies will have more complex knowledge than the least innovative ones.

Systemic vs. autonomous knowledge: Can successful innovations be based on independent 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 (Winter, 1987; Gopalakrishnan, Bierly and Kessler, 1999). In this sense, an innovation could be viewed as autonomous if it can be developed and implemented as a black box and plugged in to related components or processes (Gopalakrishnan and Bierly, 2001). However, we consider that, in order to develop successful innovations, the organizational knowledge used in the innovation process should be dependent or systemic. That is, the innovation process requires that the organization combines its existent knowledge with new knowledge. Thus, we expect than the knowledge will be more systemic in the most successful innovative companies than in the least ones.

Thus, summarizing knowledge features, we defend that the most successful innovative firms will differ from the least innovative firms in having knowledge which is more tacit, less observable, more complex and more systemic.

2.3. Knowledge exchange and combination.

The ability to create new knowledge enables firms to both innovate and to outperform their rivals, that it, it is related to innovation success (Grant, 1996; Kogut and Zander, 1992). Collins and Smith stated 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 levels of the group 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 among individuals who possess different knowledge improves the organization's ability to innovate. Thus, Seidler-de, Alwis and Hartmann (2008) find that those 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 present higher degrees of knowledge exchange than the least performers.

2.4. 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, Bessant and Pavitt, 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, Olsen and Lumpkin, 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 & Tellis, 1998) or whether a new product incorporate a substantially different core technology (Chandy & Tellis, 2000).

The *market dimension* has two different meanings in the literature. On the one hand, it is defined as *uniqueness/new customers benefits*, that is, in terms of the extent to which the new product fulfils key customer needs better than existing products (Chandy & Tellis, 1998) or provides substantially higher customer benefits (Chandy & Tellis, 2000); but on the other hand, it also has been seen 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, 1996, p. 38). It also refers to the time or difficulty to understand the new product/service concept or its advantages (Avlonitis and Salavou, 2007).

The three different meanings of radicalness are likely to relate differently with best and worst performers. Uniqueness or new customer benefits is expected to be higher for the most successful innovative companies, while newness to customers is probably to be higher for the least successful ones (Calantone, Chan & Cui, 2006; Kock, 1997). The link between best and worst performers and the technological dimension of radicalness is more difficult to predict.

In addition to the main variables analyzed in this study related to innovation success: intellectual capital, knowledge and radicalness, we also include firm performance to confirm that innovation success lead to positive consequences or results for the company as showed by previous research (Paladino, 2007).

3. RESEARCH METHOD

3.1. Sample and data collection

The companies that have been chosen for the study population belongs to manufacturing: 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 performing 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 perform new product development or improvements of existing products, and having at least fifty employees in the case of both the manufacturing industry and software or computer programming services and, at least twenty in the case of research and development services. The study population is composed of 537 companies (extracted from the SABI database), which met all these requirements.

Data collection is 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 the response of 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 & Kumar, 2008). Data were collected during 2008.

One-hundred and eighty one responses were received, which provided a response rate of 33.7%. Table 1 gives information about the companies included in the sample. A Chi-squared test applied to a contingency table with the companies of the population included and not included in the sample and the activity categories (manufacturing and services) was not statistically significant ($\chi^2_{(1)} = 1.744$, $p > 0.05$). The t test of equality of means for independent samples

showed that the difference in the mean score is not statistically significant between both groups of companies regarding the number of employees ($t_{(384)} = .392$, $p > 0.05$). Therefore, it seems that there is not a problem of non-response bias in our data due to industry and company size.

Table 1: Sample of companies

	Number of companies	Proportion
Activity		
Manufacturing	97	53.6%
Services	84	46.4%
Number of employees (size)		
Until 49	20	11.0%
50-99	77	42.5%
100-249	56	30.9%
250-499	20	11.0%
500 or more	8	4.4%
TOTAL	181	100.0%

3.2. Measures

Most of the measures have been adapted from measurement scales used and validated by previous research. We asked regarding the new or significantly improved products/services introduced by the company in the previous 5 years to measure innovation success and radicalness. Intellectual capital and knowledge are measured within the R&D department. Table 2 shows the measures used in our study.

Table 2: Measurement scales

Innovation success (at the firm level) (adapted from Avlonitis, Papastathopoulou and Gounaris's (2001) *new service performance* scale) Regarding the new or significantly improved products/services introduced by the company in the previous 5 years:

Financial performance dimension (α = .922)
IS-FP1: They were profitable. IS-FP2: Its total sales were high IS-FP3: They had a large market share IS-FP4: They exceeded its profit objectives IS-FP5: They exceeded its sales objectives. IS-FP6: They exceeded its market share objectives.
Non-financial performance dimension (α = .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: Its 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 to the company an important competitive advantage.
Intellectual capital (within the R&D department)
Human capital (α = .901) (adapted from Subramaniam & Youndt's (2005) scale) Regarding the employees of the R&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 (α = .759) (adapted from Subramaniam & Youndt's (2005) scale) Regarding the R&D department:
OC1: We use 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 (α = .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 (α = .865)

(based on Maurer & Ebers's (2006) article)
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&D department) Regarding the knowledge that incorporate new or significantly improved products/services introduced by the company in the previous 5 years:
Tacit knowledge (α = .886) (based on Hansen's (1999); Subramaniam y Venkatraman's (2001) and Norman's (2002) articles)
TAC1: It is easy to comprehensively document in manuals and report (reversed). TAC2: It can be precisely communicate through written documents (reversed). TAC3: It is easy to comprehensively understand from written documents (reversed).
Observability (α = .515) (adapted from Subramaniam & Venkatraman's (2001) scale)
OB1: It is obvious to all competitors. OB2: It is easy to identify without personal experience in the area.
Complexity (α = .866) (based on Winter (1987); Subramaniam & Venkatraman's (2001) and Gopalakrishnan, Bierly & Kessler's (1999) articles)
COM1: It requires prior learning in other technologies and related knowledge. COM2: It requires a big amount of information. COM3: It is technologically sophisticated and difficult to implement. COM4: It is complex (vs. simple).
Systemic knowledge (α = . 789) (adapted from Gopalakrishnan, Bierly y 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 (α = .945) (adapted from Collins & Smith (2006) scale) Regarding the employees of the R&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 (α = .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 5 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 (α = .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.
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: They 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.
Control variables
Activity (manufacturing vs. services)

Firm size (number of employees)

All the measures use a 7-point scale, with the exception of firm performance which ranges from 1 to 49 and control variables.

* Eliminated in an exploratory factor analysis.

Within-firm agreement among managers was assessed by the interrater agreement measure, r_{wg}, developed by James, Demaree and Wolf (1984, 1993). This indicator ranges from 0 (complete disagreement) to 1 (complete agreement). In general, the median r_{wg} values obtained suggest an acceptable degree of agreement or consistency among the respondents (Chen, Chang and Hung, 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 only 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 factorial loading; and in *systemic knowledge* the item SYS1 loaded in other factor. All the three items were deleted. With regard to reliability, Cronbach's alpha exceeded the minimum value of 0.7 recommended by Nunnally & Bernstein (1995) for all the measures, with the exception of observability, but it is higher than .5 (see Table 2). Thus, these measures seem to be reliable and valid. Number of employees (firm size) and activity are objective data obtain from the SABI database.

3.3. Analysis

Best practices studies methodology comparing best and worst performers have the advantage to provide an overall view of how companies differ in a huge amount of variables, what is usually difficult to do using regressions or SEM due to multicolinearity problems.

Two groups of firms were created based on its scores of innovation success, for both its financial and non-financial performance dimensions. The least successful innovative companies will be under the 35th percentile and the most successful over the 65th percentile in both dimensions of innovation success separately. A t-test for equally of means will confirm or not 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 due to missing data.

4. RESULTS

Means, standard deviations, and t-test for equality of means for best and worst innovative companies groups regarding to its levels of intellectual capital, knowledge, radicalness and firm performance, are showed in Table 3 for the financial dimension of innovation success and in Table 4 for its non-financial dimension.

All the dimensions of intellectual capital: human capital, organizational capital, and relational internal and external social capital have statistically significant higher means scores for best than for worst innovation performers, considering either the financial (Table 3) or the non-financial (Table 4) dimensions of innovation success.

Regarding knowledge, when the financial dimension of innovation success is analyzed (see Table 3), observability and knowledge exchange and combination means scores are greater for best performers than for worst performers, the opposite is true for tacit knowledge complexity and there are not statistically significant differences for systemic knowledge. By contrast, in the non-financial dimension of innovation success (see Table 4) only knowledge exchange and combination shows statistically significant differences 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, means scores for its technological dimension and for uniqueness/new customer benefits are significantly higher for the best than for the worst performers, considering both financial (Table 3) and non-financial (Table 4) performance dimensions of innovation success. However, the newness to customer mean is greater for the least successful innovative companies than for the most successful ones for the financial performance dimension of innovation success. Non-statistically significant differences were observed for its non-financial performance dimension.

Finally, most successful innovative companies have a greater firm performance mean than the least successful ones, using both the financial (Table 3) and non-financial (Table 4) dimension of innovation success.

There are not statistically significant differences between the two groups of companies for both dimensions of innovation success with regard to activity (financial dimension: $\chi^2_{(1)} = 1.017$, $p > 0.05$; non-financial dimension: $\chi^2_{(1)} = 2.682$, $p > 0.05$) and number of employees or firm size (financial dimension: $t_{(132)} = -.972$, $p > 0.05$; non-financial dimension: $t_{(153)} = -.574$, $p > 0.05$).

Table 3: Financial performance dimension of innovation success

	Group	n	Mean	S.D.	T-test
Intellectual capital					
Human capital	Worst	54	5.2704	.89688	- 1.866†
	Best	58	5.5603	.74503	
Organizational capital	Worst	54	4.7199	1.11141	- 2.025*
	Best	58	5.1379	1.07240	
Internal social capital	Worst	54	5.7870	.99457	- 1.820†
	Best	58	6.0905	.76225	
External social capital	Worst	52	4.8245	1.14491	- 2.342*
	Best	57	5.3070	1.00531	
Knowledge					
Tacit knowledge	Worst	56	3.1845	1.19243	- 2.680**
	Best	60	2.6778	.78825	
Observability	Worst	56	4.0045	.97409	- 2.083*
	Best	60	4.3708	.91999	
Complexity	Worst	56	4.4576	1.05509	3.030**
	Best	60	3.8097	1.23359	
Systemic knowledge	Worst	56	4.2500	1.30993	.979
	Best	60	4.0167	1.25623	
Knowledge exchange and combination	Worst	54	5.3256	.92913	- 2.121*
	Best	57	5.6740	.79950	
Radicalness					
Technological dimension	Worst	63	4.5159	1.18572	- 2.282*
	Best	71	4.9354	.93930	
Uniqueness/New customer benefits	Worst	63	5.1750	.87085	- 1.688†
	Best	71	5.4117	.75274	
Newness to customers	Worst	63	3.7831	.99590	2.842**
	Best	71	3.2473	1.16575	
Results					
Firm performance	Worst	62	22.6871	8.42694	- 5.097***
	Best	68	29.5923	7.00463	

	Group	n	Mean	S.D.	T-test
Intellectual capital					
Human capital	Worst	54	5.2704	.89688	- 1.866†
	Best	58	5.5603	.74503	
Organizational capital	Worst	54	4.7199	1.11141	- 2.025*
	Best	58	5.1379	1.07240	
Internal social capital	Worst	54	5.7870	.99457	- 1.820†
	Best	58	6.0905	.76225	
	Worst	52	4.8245	1.14491	

† p < .1; * p < .05; ** p < .01; *** p < .001

Table 4: Non-financial performance dimension of innovation success

	Group	n	Mean	S.D.	T-test
Intellectual capital					
Human capital	Worst	61	5.2377	.86990	- 3.212**
	Best	69	5.6783	.69173	
Organizational capital	Worst	61	4.7848	.99507	- 2.710**
	Best	69	5.2518	.96765	
Internal social capital	Worst	61	5.6578	.88533	- 4.143***
	Best	69	6.2156	.64272	
External social capital	Worst	57	4.8158	1.26775	- 2.614*
	Best	65	5.3308	.89689	
Knowledge					
Tacit knowledge	Worst	63	3.0635	1.18019	- 1.165
	Best	73	2.8447	1.00934	
Observability	Worst	63	4.2063	.97606	.181
	Best	72	4.1736	1.10826	
Complexity	Worst	63	3.8922	1.23226	- 1.350
	Best	73	4.1712	1.17565	
Systemic knowledge	Worst	63	4.0357	1.46866	- .608
	Best	72	4.1736	1.16177	
Knowledge exchange and combination	Worst	61	5.3975	.88603	- 2.799**

	Group	n	Mean	S.D.	T-test
Intellectual capital					
Human capital	Worst	61	5.2377	.86990	- 3.212**
	Best	69	5.6783	.69173	
Organizational capital	Worst	61	4.7848	.99507	- 2.710**
	Best	69	5.2518	.96765	
Internal social capital	Worst	61	5.6578	.88533	- 4.143***
	Best	69	6.2156	.64272	
	Worst	57	4.8158	1.26775	
	Best	68	5.8076	.77778	
Radicalness					
Technological dimension	Worst	72	4.3061	1.04187	- 5.257***
	Best	83	5.1150	.84483	
Uniqueness/New customer benefits	Worst	72	4.9487	.80460	- 5.801***
	Best	83	5.6259	.62023	
Newness to customers	Worst	72	3.4151	1.09113	- .771
	Best	83	3.5475	1.04445	
Results					
Firm performance	Worst	70	23.2786	7.90556	- 4.340***
	Best	81	28.3829	6.54433	

† p < .1; * p < .05; ** p < .01; *** p < .001

5. CONCLUSIONS AND DISCUSSION

Our research provides interesting findings about the features present in the most successful innovative companies, regarding the topics discussed: intellectual capital, knowledge and radicalness.

Regarding the elements of intellectual capital, successful innovative companies have high levels of human capital. Although the unit of analysis is R&D 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 degree of capabilities, creativity, experience, developing of new ideas and knowledge and so on.

Regarding organizational capital, the institutionalized knowledge – stored in the form of standard operating procedures, routines and scripts – is present in the most successful innovative companies in a greater extent than in less ones. It demonstrates the value of capturing and codifying knowledge in order to facilitate the transmission, disseminated, and its use by other individuals in new products.

Internal social capital, that is, a high level of quality of the relationships among individuals involved in innovative activities, also seems to be a feature of the best performers. High-quality relationships among individuals within the 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.

Similarly, the strength of the interorganizational relationships is also more present in the most successful innovative companies. As we expected, close and trustworthy collaborations between organizations can promote a more efficient transfer of complementary knowledge, facilitating innovation success.

Regarding knowledge, as expected, we have found that knowledge exchange and combination is a characteristic of the most success innovators (using both the financial and non-financial measures). This is important because previous literature had already stated that the ability to create new knowledge enables firms to both innovate and to outperform their rivals (Grant, 1996; Kogut and Zander, 1992). However, our paper is the first one showing that the

collective ability of employees to exchange and combine knowledge is really the base of knowledge creation and innovation success.

On the size of knowledge types, we have obtained some surprising findings. By definition (Nonaka, 1994) systemic, tacit, complex and not observable knowledge should influence company's perceived image and competitive advantage, and they are expected to be characteristics of the knowledge used by high innovative performers. Contrary to these expectations, we found high levels of explicit knowledge (vs. tacit), non-complex and observability of knowledge in successful innovators (at least for financial dimension). If fact, one could argue that items for tacit vs. explicit knowledge are closed to organizational capital (as codificability is used as equivalent to explicit knowledge) and it has sense to obtain high levels of codificability as levels of organizational capital were observed to be high for successful innovators as well. Anyway, other findings regarding the non-complex and observability of knowledge for financial successful innovation firms, and no differences at all in any dimension of the type of knowledge for non-financial successful innovation firms, should lead us to go deeper on such relationship. It seems that the most and least reputated companies in our research use similar kind of knowledge, what could be a plausible explanation if we take into account that all the firms develop innovative activities.

Firms with more innovation success provide uniqueness or new customer benefits, while firms with less innovation success laughs new product or services which are unfamiliar or difficult to understand by customers. This is consistent with Rogers (1985) framework, 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, as found by Gatignon et al. (2002), showing that investing in R&D to develop new technologies translate into a superior innovation success.

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

This research has some limitations. First, the sample of companies had a small size and belongs to only three Spanish industries. Therefore, there is no guarantee that the results obtained can be generalized to other sectors. However, non-response bias was not present. Second, regarding intellectual capital, we focus on the relational side of social capital, and cognitive and structural are not analyzed, what should be addressed in future research. Finally, the use of cross-sectional data shows us the differences between best and worst innovative companies just at a moment in time. Longitudinal studies would be necessary to make sure that our results do not change over time.

Our research leads to possible managerial implications. First, it seems that managers should pay attention to all the dimensions of firm's intellectual capital. Having a human capital focussed on high levels of capabilities, creativity and experience is presented as a critical issue to become an out performer innovative firm. Similarly, R&D managers should design systems by which the knowledge is codified, documented and stored, in some way that people can easily access to it. Also, improving the quality of relationships among people should appear as a concern issue for

managers. Encouraging techniques specifically created for getting trustworthy collaborations not only within the firm but with other firms/institutions seems to foster innovation success. In general, managers should take in mind that knowledge sharing and combination are characteristics of most successful innovators, who usually develop more radical innovations in the sense that provide uniqueness or new customer benefits.

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