

Human Capital, Social Capital and Technological Innovation: An Empirical Study

Miriam Delgado-Verde, Gregorio Martín-de-Castro, José Emilio Navas-López, Jorge Cruz-González

Universidad Complutense de Madrid

miriamdv@ccee.ucm.es, gregorio.martin@ccee.ucm.es, jenavas@ccee.ucm.es,
jorge.cruz@ccee.ucm.es

Abstract

Nowadays, Human capital and social capital are acquiring a growing relevance in academic studies (Dean and Kretschmer, 2007). In this sense, taking into account the importance of technological innovation within the current dynamic environment, it seems necessary to clarify their role in order to achieve different kind of innovations.

Therefore, considering mainly the Intellectual Capital-Based View (Reed et al., 2006) and paying attention to new approach about social capital, this study tries to shed light on the relationships between both concepts and product and process innovation; founding a positive and statistical significant influence on the two types of innovation in high and medium-high technology manufacturing firms, but highlighting the role of human capital.

Keywords: intellectual capital, human capital, social capital, product innovation and process innovation.

Introduction

The evolution of economic activity addresses to the so-called Knowledge Society, which is directly related to the creation, use and exchange of knowledge. In this vein, some approaches attain an main position in order to analyse the new situation, as the Resource-Based View (Wernerfelt, 1984; Barney, 1991; Peteraf, 1993; Amit y Schoemaker, 1993) or the Knowledge-Based View of the Firm (Kogut y Zander, 1992; Nonaka, 1994; Grant y Baden-Fuller, 1995; Conner y Prahalad, 1996), since they sustain the importance of intangible factors (they are knowledge in essence) for achieving business success.

Nevertheless, these perspectives have some problems regarding conceptualize, assessment and measurement of intangible resources and capabilities. So, this work is focus on the Intellectual Capital-Based View (Edvinsson and Malone, 1999; Reed et al., 2006) because overcome some limitations of those approaches. Concretely, “the Resource-Based View’s lack of specificity have raised questions as to its status as a legitimate theory, and make it difficult to design and test empirically” (Reed et al., 2006:868), reason why these authors propose a pragmatic resolution, so-called Intellectual Capital-Based View. Moreover, intellectual capital has an increasingly important role as a strategic resource in business competition (Dean and Kretschmer, 2007).

This perspective studies different blocks within intellectual capital. In this sense, there are many authors who distinguish several components (Brooking, 1996; Bontis, 1998; Sveiby, 2000; Youndt et al., 2004; Moon and Kym, 2006; Kong, 2008; among others) and trying to homogenise them, it can be asserted that intellectual capital elements are: human capital, structural capital and relational capital. However, this study will pay attention to some works that consider those components that nowadays are acquiring a growing relevance, as human and social capital (Dean and Kretschmer, 2007).

Furthermore, the new competitive dynamic generated by the new socioeconomic environment, which is competitive and uncertain, leads to pay attention to the technological innovations achievement as a key aspect for business success (Alegre et al., 2005; Jiménez and Sanz, 2006; Pizarro et al., 2007), using intangible resources and capabilities owned by a firm, that is, intellectual capital.

This way, knowledge and innovation are dominant resources in the contemporary knowledge-based economy (Tseng and Goo, 2005), being a key argument in order to carry out an empirical research like this one.

Following these arguments and due to the scarcity of empirical studies (Subramaniam and Youndt, 2005) that examine the relationship between knowledge and technological innovation from Intellectual Capital-based View, the main aim of this paper is to empirically analyze the influence of human and social capital components on product and process innovation. That is, we try to shed light on the explanatory capability of two intellectual capital components on two kind of innovation in order to contribute to needs that managers require on the innovation process. In addition, from a literature review, we propose a definition of human capital as well as social capital, dimensions that make up each components and measures for them; following the Cabrita and Bontis (2008:214)'s idea: "intellectual capital requires comprehensive theoretical and empirical development". Finally, this work emphasizes social capital, since it is the least studied within intellectual capital from a sociological view (Fukuyama, 1997) and it is attaining an important growth in the academic literature.

The paper is structured into five parts. The first presents the theoretical background, considering several approaches appropriate to analyse the firm internal and intangible factors and conceptualizing the main concepts of the study. Next, it is shown their measurement as well as stated hypotheses, taking into account interrelationships among both intellectual capital components and the two types of innovation. Third, methods used in the research, including considered sample and measures. Forth, it is tested our hypotheses, presenting the obtained results. And, finally, we explain conclusions, limitations and future research directions.

Theoretical Background

The current environment characteristics (competitive, uncertain and dynamic) lead to increase the importance to intangible resources and capabilities when firms face competitors in order to achieve and maintain a competitive advantage.

Given this situation, several theoretical perspectives attempt to give explanation about attaining business success from the firm internal factors, as the Resource-Based View (Wernerfelt, 1984; Barney, 1991; Peteraf, 1993; Amit y Schoemaker, 1993) or the Knowledge-Based View of the Firm (Kogut y Zander, 1992; Nonaka, 1994; Grant y Baden-

Fuller, 1995; Conner y Prahalad, 1996). The first one asserts that endogenous factors owned by a firm lead to a sustained competitive advantage, and, the second one states the importance of the firm role in creating, storing and applying knowledge. Specifically, some authors, as Itami and Roehl (1987) and Hall (1993), emphasize the intangible factors value, paying attention to those factors based on information and knowledge.

However, the Resource-Based View shows a main concern with respect to make operative its principles (Priem and Butler, 2001), so the Intellectual Capital-Based View appears with the aim of overcoming some problems about identifying, classifying, assessing and measuring intangible resources and capabilities, which may be an advantage competitive for a firm.

In this sense, the Intellectual Capital-Based View takes into account knowledge created by and stored in three components (Reed et al., 2006): human capital, structural capital and relations-based capital; attempting to specify several stocks of knowledge linked to a competitive advantage.

Nevertheless, this work pays attention to two components, which have acquired an important growth from 2003 (Dean and Kretschmer, 2007). On the one hand, this study examines human capital; and, on the other hand, it is necessary to divide relations-based capital into relational capital and social capital in order to analyse personal and informal relationships among employees and no-predetermined by the firm, which are included within social capital.

Furthermore, in the current environment abovementioned, technological innovation is a key issue for business competition (Schumpeter, 1942; Tushman and Nadler, 1986; Salman and Saives, 2005; Galende, 2006; among others). Concretely, Yam et al. (2004) state technological innovation can entail positive impacts, increasing the competitiveness of a firm. So, if a firm tries to survive and thrive within that kind of environment it should be continuously updated (Dannels, 2002).

Therefore, in order to go into the innovation process in depth, this work tries to pay attention to possible sources of technological innovation, analysing intangible factors from the Intellectual Capital-Based View; since the implementation of new knowledge has an important role to achieve and maintain competitive advantage (Schumpeter, 1942; Itami y Roehl, 1987; Galende, 2006).

Human and Social Capital

As we have explained above, this study starts from the Intellectual Capital-Based View in order to analyse relevant intangible factors owned by a firm when it seeks a competitive advantage.

In this sense, it seems necessary to define the concept of intellectual capital with the objective of understanding the rest of intellectual capital components. So, intellectual capital can be defined as a set of intangible resources and capabilities related to different categories of knowledge (individual, organisational or inter-organisational), which can provide a firm with competitive advantage.

However, owing to the fact intellectual capital is a broad conception; this study focuses on two important components that make up it: human and social capital. One of the main reasons

why this work emphasizes these two elements is due to recent growth within literature regarding both concept (Dean and Kretschmer, 2007) (See the appendixes: Figure 1 and 2).

Figure 1. Human Capital Results

Figure 2. Social Capital Results

In this vein, both figures show that the two components have enjoyed a high increase of researches from 2003. Nevertheless, while human capital has been widely studied and there is certain consensus with respect to its underlying ideas; social capital is not settled in the academic literature and it is analysed from several points of view and fields.

Regarding human capital, there are many authors who examine this concept from Intellectual Capital-Based View (Brooking, 1996; Steward, 1998; Edvinsson and Malone, 1999; Sveiby, 2000; Youndt et al., 2004; Reed et al., 2006; Kong, 2008; among others), understanding it as knowledge owned by people and including their abilities, motivation, creativity, experiences, education, training, etc. Moreover, Wang and Chang (2005); Moon and Kym (2007) and Wu et al. (2007) assert that this element has a strategic role in order to achieve a competitive advantage.

Therefore, this work defines human capital of a firm as knowledge and skills embedded in its staff, which are applied to carry out activities within the organization, trying to attain a competitive advantage.

With respect to social capital, this work is focus on personal and informal relationships among employees and not predetermined by the firm, understanding it from a sociological view (Fukuyama, 1997). In this sense, Macpherson and Holt (2007) state that the success of knowledge transfer and learning through networks requires specific social abilities, pointing out that social capital is made up of informal and social contacts.

Moreover, close relationships, trust and support among employees are aspects considered within social capital (Pennings et al., 1998; Oh et al., 2006; Chow and Chan, 2008). Close relationships leads to develop strong links in order to obtain a shared vision (Newell et al., 2004). Trust improves achieved results because when individuals meet and trust one another, deals are quickly obtained and they are developed without problems, groups are more productive, people learn faster and they get a major creativity (Prusak and Cohen, 2001). And, social support makes coordination and cooperation easier in order to get a common goal (Wu, 2008).

So, this study defines social capital as knowledge that derives from informal and personal relationships maintained by employees, and not predetermined by the company, which allows improving knowledge base and, therefore, the objectives achievement.

Product and Process Innovation

Many authors show the importance of innovation and its role (Schumpeter, 1942; Tushman and Nadler, 1986; Van de Ven, 1986; Alegre et al., 2005; Salman and Saives, 2005; Galende, 2006). Nevertheless, due to the fact that innovation is studied from different point of view, it is necessary to make an effort to homogenise diverse ideas appeared around this issue.

Generally, innovation can be understood as the action to introduce something new in the market. However, owing to the great quantity of existing definitions we try to identify key issues, which use to clarify this concept. In this sense, they have been found definitions that understand innovation as a process (Schumpeter, 1912; Tushman and Nadler, 1986; Damanpour, 1991; EC, 1995; Galunic and Rodan, 1998; Johnson et al., 2002; Subramaniam and Youndt, 2005; OECD, 2006; Zheng, 2009; among others) and others that understand it as a result (Van de Ven, 1986; Noria and Gulati, 1996; Adams et al., 2006; Tödtling et al., 2009). In addition, some works as Myers and Marquis (1969) or OECD (2006) pay attention to its commercialization, since innovation value depends on the market success.

So, taking into account above and adhering to underlying idea of Tödtling et al. (2009)'s work, we attempt to include both aspects, understanding that the innovation is the result of a process by which a firm, being fundamentally an intellectual capital-based-process, gets to create a new idea that will be marketed later. Furthermore, this study consider intangible factors within definition due to their importance in the innovation process, since the innovation process success depends on the firm's ability to exploit its resources (Verdú-Jover et al., 2005).

On the other hand, it is necessary to distinguish among different types of innovation because each kind of innovation requires different management approaches (Hurmelinna-Laukkanen et al., 2008). In this sense, we find technological and organizational innovation according to the nature of the innovation process; product and process innovation according to the kind of output of the innovation process; radical and incremental innovation depending on the degree of originality or novelty of innovation; architectural and modular innovation depending on the different types of changes in technology components and their links; market-pull and technological-push innovation according to the direction of the process or origin; and competence-enhancing and competence-destroying innovation depending on the effect of the innovation process on firm internal competences.

This study considers the classification that distinguishes between product and process innovations, which are included within technological innovation because it is referred to changes in products and processes (Oslo Manual, 2006). That choice is due to its acceptance and recognition in the academic literature as well as to the fact that product innovation is one of the most promising areas in the field Knowledge Management (Corso et al., 2001).

Product innovation can be understood as the introduction of a new product or service or significantly improved in terms of features, or intended use; and process innovation is the introduction of a new, or significantly improved, production or distribution process (OECD, 2006).

Research Framework

According to Edvinsson and Sullivan (1996), and Hermans and Kauranen (2005), an adequate intellectual capital leads to develop innovations. However, Tödting et al. (2009) assert that it is still unclear as to what extent different types of innovation rely on specific knowledge. Moreover, Darroch and McNaughton (2002) state that existing literature should provide empirical evidence with respect to the relationship between intellectual capital and innovation.

Following these arguments, this work presents four hypotheses with the aim of shedding light on such issue. Thus, starting from general thesis “intellectual capital is a source of technological innovation”, we provide some ideas in order to support the relationships among human and social capital, and product and process innovation.

Generally, several authors emphasize the importance of human capital, highlighting that it is the core and precursor of the rest of intellectual capital components (Wang and Chang, 2005; Wu et al., 2007; Moon and Kym, 2007). In this sense, employees contribute to the firm development and advance by means of their individual knowledge.

The diversity of human capital, as educational as functional experience, promotes the search for knowledge and organizational learning processes, achieving product and process innovation (Hayton, 2005). It is due to the fact that such diversity or heterogeneity involves a wide cognitive level, making the knowledge obtaining easier. On the other hand, a higher level of education facilitates the communication inside a firm, providing a shared knowledge base in order to integrate knowledge (Leiponen, 2006). In addition, professional experience means obtaining knowledge generated in others companies, which contributes an important value in order to attain product and process innovations (Díaz et al., 2006).

Furthermore, constant improvement of employees' abilities is a key aspect to maintain a high quality workforce and, therefore, adapting to market demand changes and introducing product and process innovations efficiently (Hedge and Shapira, 2007). Finally, the employees' specificity, that is, valuable highly knowledge, means a better information processing, a faster learning and its efficient application; highlighting that a unique and exclusive knowledge is required to carry out an innovation (Pizarro et al., 2007).

Thus, we propose the following hypotheses:

H1a: The higher human capital endowment in a firm, the higher its product innovation results

H1b: The higher human capital endowment in a firm, the higher its process innovation results

According to Zheng (2009), social capital is considered as the new approach to explain innovation success, since innovation is achieved by means of knowledge and experience combination and exchange (Nahapiet and Ghoshal, 1998). In addition, Macpherson y Holt (2007) assert that the knowledge transfer and learning success through networks requires specific social abilities, showing that social capital is made up of informal and social contacts.

In this sense, Wu et al. (2008) emphasize confidence, mutual respect and shared information and vision among employees on the relationship between social capital and innovation. So, it is necessary to develop strong links among employees in order to get a

shared sense of purpose and common understanding (Newell et al., 2004), which are attained by close relationships (Chow y Chan, 2008).

Therefore, when employees trust everybody else, they have a shared vision, close ties and social support; interaction among them improve, deals are faster and developing without problems, people are more productive and having a more potential to create new knowledge, and a high creativity level is obtained, (based on Madhavan and Grover, 1998; Prusak y Cohen, 2001; Moran, 2005; Swart, 2006; Chow and Chan, 2008; Wu et al., 2008).

Thus, following these arguments, we propose two hypotheses:

H1a: The higher social capital level in a firm, the higher its product innovation results

H1b: The higher social capital level in a firm, the higher its process innovation results

Population, Sample and Methods

From the SABI database, we obtained a total number of 1270 firms, which fulfill the following characteristics: (i) they are high and medium-high technology manufacturing firms; (ii) they have fifty or more employees; and (iii) they are Spanish firms.

With respect to the first characteristic, we pay attention to those firms based on knowledge because they have a strong dependence on intellectual capital (Johnson et al. (2002). Moreover, Leitner (2005) pointed out that high and medium-high technology industries are focus on intangible factors. On the other hand, some authors as Rouse and Daellenbach (1999) or King and Keithaml (2003) assert that selected firms should belong to an homogeneous industry in order to avoid different effects derived to environmental characteristics.

In addition, regarding high and medium-high technology manufacturing firms size, due to the fact that Spanish industry only have a 2.8% of 100 or more employees, even though Subramaniam and Youndt (2005:455) state that “organizations with more than 100 full-time employees are more likely to have somewhat formalized R&D and innovation systems”, we take into account to firms with 50 or more employees with the aim of achieving unless a 5.5% of that industry.

The next step was to collect data and, in this sense, we used an “ad-hoc” questionnaire (7-point Likert scale) in order to find valuable and unique competences of a firm, since they can lead to competitive advantage (Penrose, 1959), being the method recommended to collect this kind of data (Zahra and Covin, 1993). Furthermore, the measurement of intangible factors needs to develop specific items to approach to target variables.

After sending the questionnaires, 251 firms took part in our study, obtaining a response rate of 17.07%, with a sampling error of +/- 5.5% for a 95% of confidence level. At this point, it is convenient to highlight that the respondents of the questionnaire were managers because they have a wider vision of their firms (Cabrita and Bontis, 2008).

Once explaining the most characteristic aspects about population, sample and methods, it is shown the empirical research resume (see the appendixes: Table 1):

Table 1. Empirical Research Resume

Measures

From a wide review of the literature, on the one hand, we designed the two main constructs of our research (human capital and social capital), considering several dimensions which make up each one of them; and, on the other hand, we considered the two dependent variables (product innovation and process innovation). In addition, we took into account two control variables (firm size and age).

Regarding human capital, we try to get information from employees' education and training (Snell and Dean, 1992; James, 2000; Zárraga and Bonache, 2005; Wu et al., 2008; among others); employees' experience and abilities (Lepak and Snell, 2002; Youndt et al., 2004; Subramaniam and Youndt, 2005; Reed et al., 2006; among others); and employees' motivation (Huselid, 1995; Carmeli and Tishler, 2004; Chen et al., 2004; Moon and Kym, 2006; among others), using nine items gathered in those three dimensions (see the appendixes: Questionnaire).

Social capital was measured with seven items, considering social networks (Chen et al., 2008; Wu et al., 2008); shared vision (Tsai y Ghoshal, 1998; Chow y Chan, 2008); and confidence and social support (Rodan y Galunic, 2004; Zárraga y Bonache, 2005) among employees, as dimensions (see the appendixes: Questionnaire).

With respect to two types of innovation, product innovation (Zahra and Covin, 1993; Chandy and Tellis, 1998; Souitaris, 2002; Chen et al., 2004; Akgün et al., 2007; Jensen et al., 2007; Wu et al., 2008; among others) and process innovation (Zahra and Covin, 1993; Souitaris, 2002; Wang and Ahmed, 2004; Wu et al., 2008; among others), each of them were measured by three items (see the appendixes: Questionnaire).

Results

The data processing was carried out by means of two stages. The first one is divided into exploratory and confirmatory factor analyses in order to identify the configuration of the two capitals; and the second one is referred to regression analysis in order to test our hypotheses.

Exploratory and Confirmatory Factorial Analyses

The reasons to carry out an exploratory factorial analysis are the following ones: (i) to reduce items of each capital by factors with the aim of summarizing information and understanding it better; and (ii) to provide different dimensions that make up each capital, trying to contribute a deeper analysis regarding others' studies. And, in order to observe the uni-dimensionality of measures of every dimension of each capital (first order) and to check that the obtained dimensions fit to each capital and not to another construct (second order), it is carried out the confirmatory factorial analysis.

In the first place, in order to test the convenience of the exploratory factorial analysis (EFA), we pay attention to the KMO index, the Bartlett's test significance level and the matrix determinant value. These indexes should have values higher than .7; less than .05 and close value to 0, respectively (Hair et al., 2004).

And, in the second place, with regard to confirmatory factorial analysis (CFA), we analyse the fit of the data through chi-squares/degrees of freedom ratio, GFI (Goodness of Fit Index), AGFI (Adjusted Goodness of Fit Index), RMSEA (Root Mean Square Error of Approximation), IFI (Incremental Fit Index), and CFI (Comparative Fit Index) index, as first

order as second CFA. In this sense, according to Hu and Bentler (2000), GFI, AGFI, IFI and CFI should show close value to .95; RMSEA should be less than .08 (Browne and Cudeck, 1993); and the chi-squares/degrees of freedom ratio (CMIN/df) should be less than 3.

Furthermore, we consider Cronbach's Alpha coefficients to determine the reliability level of each capital as well as their dimensions, and of product and process innovation, as well. According to Hair et al., (2004) and Pardo and Ruiz (2005) these coefficients should be higher than .7 to confirm that the measures utilized are valid and internally consistent.

In this vein, we present the data regarding human capital, social capital, product innovation and process innovation.

As we said above, human capital is made up of nine items and, once applied varimax orthogonal rotation in order to achieve a better adjustment within EFA, they were gathered in three dimensions (see the appendixes: Table 2), getting the following satisfactory results: the KMO index = .802; the Bartlett's test significance level = .000; and the matrix determinant value = .032. Moreover, human capital factors have a percentage of explained variance of 67.168.

Table 2. Human Capital EFA

The first factor "Education and Training" (E&T) consists of knowledge acquired through higher education and specific training received by a firm. Besides, the internal promotion is considered within this factor, since it is included on employees development and the latter is jointly considered with training (Fitzgerald, 1992). Its percentage of explained variance is 27.847, and the Cronbach's alpha value is .788, fulfilling with the reliability analysis.

The second factor "Motivation" (Mot) is referred to employees motivation, including their satisfaction and commitment to their firm, because these employees will be the most motivate employees to achieve planned goals. Its percentage of explained variance is 20.483, and the Cronbach's alpha value is .720, exceeding the demanded value.

The third factor "Experience and Abilities" (E&A) includes knowledge acquired by the time through employees practice and intrinsic abilities. Regarding HC6, it is necessary to explain that it has been consider within the factor 3, instead of the factor 2, because it is related to employees skills, although the development of new ideas and knowledge could be a consequence of the motivation. In addition, if it were considered within the factor 2, KMO index and Cronbach's alpha would reduced to .779 and .655, respectively. Its percentage of explained variance is 18.838, and the Cronbach's alpha value is .680, exceeding the mentioned value above.

Once realized the EFA, we carry out the first as well as second order CFA, obtaining a good model fit, since every indexes fulfill with levels suggested by Hu and Bentler (2000) and Browne and Cudeck (1993): CMIN/df = 2.464; GFI = .952; AGFI = .910; RMSEA = .077; IFI = .958; and CFI = .957.

Social capital is made up of seven items and, as human capital, it was applied varimax orthogonal rotation in order to achieve a better adjustment within EFA, obtaining three dimensions (see appendixes: Table 3). And, in the same way, the results were satisfactory: the KMO index = .929; the Bartlett's test significance level = .000; and the matrix

determinant value = .005. Furthermore, social capital factors have a percentage of explained variance of 85.051.

Table 3. Social Capital EFA

The first factor “Shared Vision” (Vis) takes into account the degree in which employees have common aspirations, perspectives and enthusiasms. Its percentage of explained variance is 38.778, and the Cronbach’s alpha value is .888, fulfilling with the reliability analysis.

The second factor “Confidence and Social Support” (C&S) represents the good willingness among some employees with respect to share experience and knowledge as well as facilitated help each other. Regarding mutual help (SC7), this item loads in a similar way in the three factors, specially in factor 1 and 2; however, as a result of literature review and due to the fact that it is not related to shared vision, we consider it within factor 2, obtaining the highest load. Its percentage of explained variance is 23.706, and the Cronbach’s alpha value is .856, exceeding the demanded value.

The third factor “Social Networks” (Net) includes existing links among some employees, paying attention to ideas and information exchange as well as constructive discussions maintained by them. With respect to that last item, it can be observed that it has two similar loads on factor 1 and 3; nevertheless, from realized review, personal relationships strength is considered within factor 3, since it is represented within social network. Its percentage of explained variance is 22.567, and the Cronbach’s alpha value is .773, exceeding the mentioned value above.

The next step was to carry out the first as well as second order CFA, and as human capital, it was obtained a good model fit: CMIN/df = .902; GFI = .990; AGFI = .974; RMSEA = .000; IFI = 1.001; and CFI = 1.000.

Finally, product and process innovation were measured with three items each of them. In this case, it was only necessary to carry out EFA (see appendixes: Table 4 and 5), since both variables are single-dimensionals. Thus, from a varimax orthogonal rotation, we got the following satisfactory results: the KMO index = .775 and .645, respectively; the Bartlett’s test significance level = .000; and the matrix determinant value = .049 and .315, respectively. Moreover, they had a percentage of explained variance of 91.009 and 71.463, respectively. Finally, both fulfill with the reliability analysis, obtaining a Cronbach’s alpha value of .951 and .792, respectively.

Table 4. Product Innovation EFA

Table 5. Process Innovation EFA

Relationships Analyses

Once the dimensions of human capital and social capital, and product and process innovation have been obtained, a multiple regression model was designed with the aim of testing our hypotheses. However, before results interpretation, the normality of dependent variables was verified, obtaining satisfactory outputs through Q-Q graphs.

So, according to the multiple lineal regression rules, we analyse the influence of human and social capital on product and process innovation (see appendixes: Table 6). In this sense,

regarding product innovation, Durbin-Watson's value indicates that the residues are independent and the statistician F value shows a linear significant relation between product innovation and dimensions of human capital as well as dimensions of social capital, showing the statistical validity of the proposed model. Thus, as it can be seen in table 4, all dimensions of each capital have a positive and significant statistically influence on product innovation, being the R^2 of human capital higher than R^2 of social capital. So, human capital has a major explanatory power on product innovation with a 35.1% in comparison to 14.3% of social capital. In addition, it is interesting to highlight that dimension "Education & Training" has the greatest effect regarding human capital dimensions, and in the case of social capital it is the dimension "Shared Vision" the major one. Therefore, our expectations are proved, supporting hypotheses 1a and 2a.

On the other hand, with respect to process innovation, again Durbin-Watson's value indicates that the residues are independent and the statistician F value shows a linear significant relation between process innovation and dimensions of human capital as well as dimensions of social capital, showing the statistical validity of the proposed model. Thus, as product innovation regression, all dimensions of each capital have a positive and significant statistically influence on process innovation, being the R^2 of human capital higher than R^2 of social capital. So, in this case, human capital has also a major explanatory power on process innovation with a 23% in comparison to 18.6% of social capital, but to a lesser extent than before. And, again, the dimension "Education & Training", within human capital, and the dimension "Shared Vision", within social capital, have the greatest effect on process innovation. Therefore, our expectations are also proved, supporting hypotheses 1b and 2b.

Finally, control variable "age" only has a relevant role on product innovation when we analyse social capital, understanding that personal relationships will be more steady in those firms that have been more time in the market.

Table 6. Results of Regression Analyses

Conclusions, Limitations and Future Research Directions

Taking into account arguments as those shown by Tseng and Goo (2005) regarding the importance of knowledge and innovation in the contemporary knowledge-based economy; Cabrita and Bontis (2008:214) who assert "intellectual capital requires comprehensive theoretical and empirical development"; Subramaniam and Youndt (2005) with respect to the scarcity of empirical studies that examine the relationship between knowledge and technological innovation from Intellectual Capital-based View; Dean and Kretschmer (2007) about the growing relevance of human and social capital studies; this research contributes with satisfactory results, providing strong support for the hypotheses about the relationships between human and social capital, and product and process innovation.

In this sense, from Intellectual Capital-based View, we found that human and social capital are two important sources of product and process innovation within high and medium-high technology Spanish manufacturing firms; considering different dimensions of each capital in order to compare the importance of each of them, since different types of innovation will require using and managing different resources within the firm (McEvily et al., 2004).

Thus, we identified three dimensions within each type of capital. Regarding human capital, we found "Education & Training", "Motivation", and "Experience & Abilities", being

the most interesting the first one, so this dimension is a key factor to carry out product and process innovation. Therefore, it will be necessary a good base of specific knowledge and related to task to achieve them. In this sense, according to Hedge and Shapira (2007), the continuous improvement in the employees training is essential for maintainin a high quality work force in order to adapt to changes of the market demand and for assuring the effective implementation and introduction of product innovation through process innovation.

With respect to social capital, we found “Shared Vision”, “Confidence and Social Support”, and “Social Networks”, being the most interesting the first one, so this dimension is a key factor to carry out product and process innovation. Thus, it seems important to have common misions and objectives among employees who maintain close relationships in order to address to the same achievement and obtaining success.

Contrary to our expectations, there are not important differences on required knowledge when it comes to carry out a type of innovation. Nevertheless, we can state what type of capital has a major explanatory power by means of corrected R^2 : human capital in both case.

In addition, in the professional field, managers need tools to evaluate their management and the outcomes of the innovation activities. Thus, due to changing and complex consumers demands, which have lead to an increasing range of products and services, it is fundamental to emphasize the relevance that the innovation process in the present business landscape, so knowledge as well as its applications are key elements for achieving and maintaining business success.

Therefore, an empirical study with these characteristics provides evidence about what managerial actions should be taken by firms when dealing with their intellectual capital, identifying the knowledge and processes with a higher potential for different successful innovations.

In this sense, human capital is a key factor in order to achieve product and process innovation, considering issues as education, training, motivation, experience and abilities; so firms should give importance to hire people with higher education and experience; to provide training courses to their employees, improving their abilities, and to motivate them through rewards and encouragement. But taking into account there are other important factors as social capital and trying also to apply them.

There are several limitations in this study. Some of them are the following ones: firstly, we collected primary and subjective data, being interesting to consider objective data, as well, and combine them. Secondly, the findings of this empirical research can not be generalized for any kind of industry, since our sample is referred only to high and medium-high technology manufacturing sectors. For this reason, implications for managerial practice can only be obtained for these industries. Finally, the dynamism of factors that affect firms has not been taken into account and how the change by firms as time goes by. This is a consequence of using a cross-sectional survey instead of carrying out a longitudinal study.

Therefore, as future research directions, it would be interesting (i) to work with objective secondary data, combining them with the ones obtained in this study, as Penrose (1959) suggests; (ii) to analyse those relationships between human and social capital, and product and process innovation in another industry, since sources of innovation are different depending on industry (Vega-Jurado et al., 2008); and (iii) to analyze the phenomenon of

complementarity between both capitals, and to provide a deep study about their link and if that connection creates value for a firm from a technological innovation process viewpoint; considering the arguments gathered by Oh et al. (2004), Subramaniam and Youndt (2005) and Batjargal (2007).

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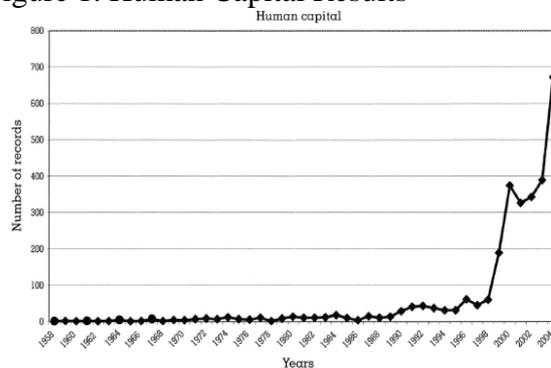
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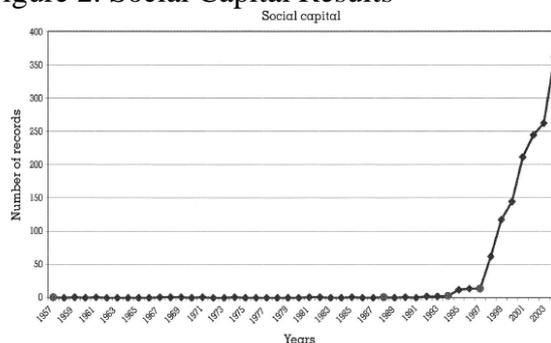
Appendixes

Figure 1. Human Capital Results



Source: Dean y Kretschmer (2007:590)

Figure 2. Social Capital Results



Source: Dean y Kretschmer (2007:591)

Table 1. Empirical Research Resume

<i>Target Population</i>	1270 high and medium-high technology manufacturing firms
<i>CNAE-93</i>	24, 29, 30, 31, 32, 33, 34, 35
<i>Firm Size</i>	50 or more employees
<i>Geographic Zone</i>	Spain
<i>Gathering Data</i>	“ad-hoc” Phone questionnaire
<i>Sample Size</i>	251 valid questionnaire
<i>Response Rate</i>	17.07%
<i>Sampling Error</i>	+/- 5,5%
<i>Sampling Technique</i>	Random algorithm of Pascal’s language
<i>Statistical Software</i>	SPSS 17.0 and AMOS 7.0
<i>Fieldwork</i>	From 28th February to 5th May 2009
<i>Respondents</i>	Managers

Table 2. Human Capital EFA

HUMAN CAPITAL ITEMS	Component		
	1 E&T	2 Mot	3 E&A
HC2: Training inside the firm	0.888		
HC1: Employed resources in training activities	0.857		
HC3: Employees with university degree	0.670		
HC9: Use of internal promotion	0.599		
HC8: Commitment and responsibility		0.832	
HC7: Employee satisfaction index		0.804	
HC4: Employee experience			0.843
HC5: Employee valuable abilities			0.741
HC6: Development of new ideas and knowledge		0.479	0.481
% Explained variance	27.847	20.483	18.838
% Accumulated variance	27.847	48.330	67.168
Cronbach’s α	0.788	0.720	0.680

Table 3. Social Capital EFA

SOCIAL CAPITAL ITEMS	Component		
	1 (Vis)	2 (C&S)	3 (Net)
SC3: Same ambitions and vision	0,821		
SC4: To agree on what is important at work	0,802		
SC5: Enthusiastic about goals	0,764		
SC6: To share their knowledge and experience		0,893	
SC7: Mutual help	0,584	0,586	0,414
SC1: To exchange idea and information in informal			0,891
SC2: Constructive discussion	0,532		0,541
% Explained variance	38,778	23,706	22,567
% Accumulated variance	38,778	62,484	85,051
Cronbach’s α	0,888	0,856	0,773

Table 4. Product Innovation EFA

PRODUCT INNOVATION ITEMS	Component
	1 (Prod.I)
Prod.I1: Number of Product Innovation	0,958
Prod.I2: Percentage of sales with respect to new products	0,954
Prod.I3: Number of new products with respect to product portfolio	0,950
% Explained variance	91,009
Cronbach's α	0,951

Table 5. Process Innovation EFA

PROCESS INNOVATION ITEMS	Component
	1 (Proc.I)
Proc.I3: New processes with a reduction in the production costs	0,898
Proc.I2: New processes with a reduction in the manufacture cycle and/or an improvement in the productive flexibility	0,895
Proc.I1: Number of process innovations	0,732
% Explained variance	71,463
Cronbach's α	0,792

Table 6. Results of Regression Analyses

VARIABLES	PRODUCT INNOVATION		PROCESS INNOVATION	
	HC (H1a)	SC (H2a)	HC (H1b)	SC (H2b)
E&T	.506***		.389***	
Mot	.254***		.235***	
E&A	.203***		.194***	
Vis		.265***		.334***
C&S		.182***		.162***
Net		.236***		.254***
Age	.047	.101*	.032	.086
SizeLog	-.062	-.057	-.012	-.015
MODEL RESUME				
Corrected R ²	.351	.143	.230	.186
T. Mistake	.8056	.9255	.8774	.9024
Durbin-Watson	1.936	.060	1.973	1.974
F	28.033***	9.373***	15.945***	12.406***

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

Questionnaire items (7-point Likert scale: 1 “strongly disagree”; 7 “strongly agree”)

HUMAN CAPITAL

My company allocates resources (money, time, etc.) to employees training in a higher extent than my competitors
In my company, the percentage of people who receives training is higher than my competitors
In my company, the percentage of people with superior degree (bachelor, engineer, masters, etc.) is higher than my competitors
In my company, the percentage of filled job by means of internal promotion is higher than my competitors
The experience that has our employees is appropriate to carry out satisfactorily their work
Our employees own abilities that are widely considered the best in our industry
Our employees develop new ideas and knowledge
Generally speaking, our employees are satisfied in the company
Employees are compromised and they maintain a high sense of responsibility with the company

SOCIAL CAPITAL

In my company, there are employees and/or teams who build informal network relationships in order to exchange idea and information about new product development
In my company, there are employees and/or teams who discuss to each other in a constructive way when things go wrong
In my company, there are employees and/or teams who share the same ambitions and vision at work
In my company, there are employees and/or teams who agree on what is important at work
In my company, there are employees and/or teams who are enthusiastic about pursuing their collective goals and missions
In my company, there are employees and/or teams who are not reluctant to share their knowledge and experience
In my company, there are employees and/or teams who help each other in order to generate new ideas and/or enhance your ability to do your daily job

TECHNOLOGICAL INNOVATION

In the last 3 years, the number of product innovations developed by my company is higher than the one of my competitors
The percentage of sales with respect to new products, on the total of sales, is higher than the one of my competitors
In the last 3 years, the number of new products with respect to my product portfolio is higher than the one of my competitors
The number of process innovations introduced by my company is higher than the one of my competitors, in the last 3 years
The new processes introduced by my company in the last 3 years suppose a reduction in the manufacture cycle and/or an improvement in the productive flexibility
The new processes introduced by my company in the last 3 years suppose a reduction in the production costs