

## **Leveraging the innovative performance of human capital through HRM and social capital in Spanish firms**

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Literature on Intellectual Capital provides interesting arguments about the key role of social and human capital, not only separately but also jointly, for innovation activities. Thus, given the acknowledged importance of these variables, this article studies (1) the direct relationship between social and human capital and innovative performance, (2) the links between these two components of intellectual capital, as well as the possible mediating role of human capital, (3) the effect of particular human resource management (HRM) practices (selection procedures, development programmes, empowerment and use of incentives on compensation) on social and human capital, and (4) the influence of innovative performance on firm performance. In our study, we define a population of firms in the most innovative Spanish sectors for an empirical test of this model, focusing on their R&D departments. Using data taken from 85 firms and applying Structural Equation Models, we have tested the hypotheses and obtained interesting results. It is the uniqueness of human capital, and not its value, which has a direct and positive effect on firm innovativeness. Such uniqueness, in turn, is enhanced through social capital and HRM practices such as empowerment and employee selection based on learning potential and interpersonal abilities. Social capital does not have, *per se*, a direct influence on innovation, but it indirectly does through human capital. Social capital, in turn, can be enhanced by the selection of individuals with learning potential and interpersonal skills, as well as by their involvement in decision-making processes. Finally, innovation improves firm performance.

**Keywords:** firm performance; human capital; human resource management practices; innovation; social capital

### **Introduction**

Intellectual capital, conceptualized as the knowledge and knowing capability of an organization (Nahapiet and Ghoshal 1998), represents one of the most relevant antecedents of innovation, which has become fundamental for achieving competitive advantage (Van de Ven 1986; Brown and Eisenhardt 1995; Van de Ven and Poole 1995; Hamel 1998; Darroch and McNaughton 2002; Martinez-Ros and Salas-Fumás 2004; Zhou 2006). Moreover, it is widely accepted that firms' innovation capabilities are more closely linked to their intellectual capital than to their fixed assets (Quinn, Anderson and Finkelstein 2005; Subramaniam and Youndt 2005). The importance of intellectual capital for innovation has attracted researchers interested in determining its elements and the process by which it enhances the innovative capabilities and performance of firms.

Although organizations may develop the three aspects of intellectual capital independently (human, social and organizational capital), one of the most suggestive ideas

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that has emerged from this framework concerns the potential for interaction between them, and how such interactions may improve innovative performance. In this sense, the intellectual capital approach considers that human capital could be leveraged by other dimensions of intellectual capital to create new knowledge (McFadyen and Cannella 2004; Subramaniam and Youndt 2005; Reed, Lubatkin and Srinivasan 2006). Indeed, although human capital may be the origin of all knowledge, learning requires that individuals exchange and share insights, knowledge and mental models, which represent social capital (Senge 1990). Given that innovation is essentially an exercise in collaboration, social capital plays a key role both directly improving human capital and stressing its effects on innovation. Therefore, improving individual knowledge and creating the conditions for sharing it are issues that deserve attention. Nevertheless, although these relationships among different elements of intellectual capital are worth analysing, little is known about the empirical effects of social capital on human capital or about the effects of these relationships on innovativeness.

Given the recognized importance of human and social capital for innovation, an interesting question emerges: how can organizations ensure high levels of these two components of intellectual capital? Research has highlighted the role of human resource management (HRM) as a means of managing human and social capital. Youndt, Subramaniam and Snell (2004) demonstrate that HRM investment has a significant role to play in creating human and social capital. Nevertheless, they do not consider separately the effects of specific HRM practices. Subramaniam and Youndt (2005) conclude that an organization's efforts in hiring, training, designing work and implementing other HRM practices may need to focus not only on maintaining their employees' functional or specific technical skills and expertise but also on developing their abilities to network, to collaborate and to share information and knowledge. As a consequence, in our research, we propose that both human and social capital could be enhanced through implementing HRM practices that promote both the competence of individual employees and their willingness to interact and to share knowledge.

Therefore, as our main objective, we want to contribute to the literature by analysing these aspects of intellectual capital (social and human capital) in connection with innovation, and the role played by particular HRM practices in this area. Specifically, we study: (1) the direct relationship between social and human capital and innovative performance, (2) the links between these two components of intellectual capital, as well as the possible mediating role of human capital, (3) the effect of particular HRM practices on social and human capital and (4) the influence of innovative performance on firm performance.

Besides the study of these relationships, this research aims to overcome the problem of using aggregated measures of human and social capital at the organizational level, which has been criticized by some authors. In this sense, Downs and Mohr (1976) criticized researchers for analysing organizational variables as if they are features that characterize the whole organization, because they may be heterogeneous. Subramaniam and Youndt (2005) identified this practice as a limitation to this type of research because it is difficult to obtain an aggregate measure of intellectual capital. This explains why we undertake a department-level analysis by focusing our study on R&D departments. Although it is clear that knowledge could be generated by the organization as a whole, it is arguably the case that the influence of human and social capital on innovation is especially relevant in these R&D departments, given their major contribution to innovation.

Our study contributes to the existing literature on innovation and HRM. First, by discussing the influence exerted by social capital on human capital, we can reach a better

understanding of their direct and combined effects on innovation. Second, by testing empirically that both human and social capital can be enhanced through specific HRM practices, we contribute to the HRM literature. Third, we suggest that our focus on R&D departments leads to a better understanding of the specific variables (employees' knowledge, relations and practices) that affect firms' innovation.

Below, we first explain the theoretical arguments used to establish the hypotheses tested in this study, based on the insights provided by the intellectual capital, HRM and innovation approaches. Then, we empirically test our hypotheses based on a sample of Spanish industrial companies. Finally, we discuss our findings and draw conclusions from this study.

## **Theoretical review**

### ***Human capital and innovative performance***

Innovation has become fundamental for achieving competitive advantage (Van de Ven 1986; Brown and Eisenhardt 1995; Van de Ven and Poole 1995; Hamel 1998; Darroch and McNaughton 2002; Martinez-Ros and Salas-Fumás 2004; Zhou 2006) and is currently one of the principal topics of debate in the management literature (Sørensen and Stuart 2000). Although organizational factors that may facilitate such innovations include technologies, managerial support, specific firm design and the like, the existing literature emphasizes the role of individual knowledge working in an organization (human capital) as the primary resource for innovation (Boxall 1996; Teece, Pisano and Shuen 1997; Barney and Wright 1998; Argote and Ingram 2000; Alegre, Lapiedra and Chiva 2006).

The human capital of an organization is defined as the knowledge, skills and abilities (KSA) residing with and utilized by individuals (Subramaniam and Youndt 2005, p. 451). Given the close connection between the knowledge possessed by the personnel of the firm and its products and services, 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). Considering the human capital approach, the value and uniqueness of knowledge are the most relevant features for innovation (Lepak and Snell 1999; Subramaniam and Youndt 2005).

Value refers to the potential to improve the efficiency and effectiveness of the firm, exploit market opportunities and/or neutralize potential threats (Lepak and Snell 2002, p. 519). As Barney and Wright (1998) suggested, resources may create value either by decreasing product or services costs or by differentiating products or services in a way that allows the firm to charge a premium price. Valuable knowledge yields high returns in markets which increase the ratio of benefits to customers relative to their associated costs (Wernerfelt 1984; Snell, Lepak and Youndt 1999; Lengnick-Hall and Lengnick-Hall 2003). Regarding innovation, employees with valuable knowledge and skills are positively associated with innovative capacity, because they contribute to the identification of new market opportunities, and employees with such knowledge are willing to experiment and apply new procedures (Costa and McCrae 1992; Taggar 2002). As Subramaniam and Youndt (2005) pointed out, it is among these individuals that organizations find the greatest collection and diversity of skills. These employees are also the most flexible in acquiring new skills, which enhance the firm's innovative performance.

The second feature of human capital is its uniqueness. Uniqueness makes an employee irreplaceable and idiosyncratic, and his or her rare and firm-specific KSA (Barney 1991) may be difficult to transfer to other positions and for other firms to duplicate (Lepak and Snell 1999; Lengnick-Hall and Lengnick-Hall 2003). This unique human capital may

generate competitive differentiation because valuable but common (i.e. not rare) resources and capabilities are sources of competitive parity (Barney 1995; Snell et al. 1999). In addition, people with unique KSA are considered 'rainmakers', and their specialized knowledge contributes to the development of new ideas and products (James 2002). By contrast, generic knowledge is rarely the source of innovative activity because it is widely available in the market (Nonaka and Takeuchi 1995). Amar (2002) suggests that employees possessing rare KSA are not commonly observed in the labour market. Therefore, their knowledge is also new to competing firms and thus it constitutes an intangible resource for firm innovation. On the basis of the above arguments, we propose our first hypothesis.

*Hypothesis 1:* Human capital is positively associated with innovative performance.

*Hypothesis 1a:* Valuable human capital is positively associated with innovative performance.

*Hypothesis 1b:* Unique human capital is positively associated with innovative performance.

### ***Social capital: influences on innovative performance and human capital***

Social capital is the second aspect of intellectual capital that we study. It has been conceptualized as the sum of the actual and potential resources embedded within, available through and derived from the networks of relationships possessed by an individual or social unit (Nahapiet and Ghoshal 1998). Spender (1996) uses the term 'collective knowledge', which is tacit and situated in a social dimension. Because of this, it is the most difficult aspect of intellectual capital to manage and measure. This may also explain why it is the most strategic type of knowledge (Spender 1996). On the basis of the work of Granovetter (1992), several researchers have highlighted two main aspects of social capital: structural embeddedness and relational embeddedness.

Nahapiet and Ghoshal (1998) define structural embeddedness as the personal configuration of linkages between people or units, which includes the pattern of relationships among economic actors (with whom and how these relationships take place) and the existence of network ties and network configuration in terms of density, connectivity and hierarchy, besides other aspects. Relational embeddedness relates to the type of relationships that people develop among themselves over time. Relational embeddedness emphasizes the aspects of relationships that influence people's behaviour, such as friendship, trust and respect.

Structural embeddedness and relational embeddedness have different effects on performance; although the former relates to the structure of networks (determining with whom each person maintains contact), the latter focuses on the quality of these relationships (Moran 2005). In this sense, the higher the degree of proximity or familiarity of the relationships, the greater the transfer of resources, tacit knowledge and complex knowledge. In these circumstances, managers are more willing to support and motivate innovative activities by providing the necessary backing to entrepreneurs to transform their ideas into successful projects. Moran's (2005) results suggest that the relational dimension influences innovation tasks more than does the structural dimension. Thus, our research focuses on the relational aspect of social capital.

Other researchers have highlighted the importance of the relational side of social capital for innovation. Tsai and Ghoshal (1998) demonstrate that this relational dimension positively influences resource exchange and the coordination among the people involved, which, at the same time, creates value for the firm through its effect on product innovation. Moreover, Lee, Wong and Chong (2005) state that the relational dimension, characterized

by high levels of trust and friendship, makes people more willing to engage in social exchange and cooperative interaction, which involves, e.g. relying on others, asking for help, having spontaneous conversations and unplanned meetings, and sharing information, knowledge and resources. Given that social capital theory emphasizes friendship and trust for the relational dimension, the quality of communication is an important determinant (Watson and Papamarcos 2002). In this sense, research in this field has highlighted the role of communication and information gathering for organizational innovation (Monge, Cozzens and Contractor 1992). Subramaniam and Youndt (2005) argue that innovation is essentially a collaborative effort and that, thus, communication, the fluid diffusion of information, and the sharing and assimilating of knowledge are vital elements of innovative capabilities. Similarly, Nahapiet and Ghoshal (1998) argue that the relational dimension of social capital may represent an increased willingness to experiment with combining different types of information as well as to develop new knowledge. Thus, we can state our second hypothesis.

*Hypothesis 2:* The relational side of social capital is positively associated with innovative performance.

However, we assume that social capital not only has a direct effect on innovation but also affects innovation through its effect on human capital. Given that both social capital and human capital are aspects of intellectual capital, which is the basis of innovation, we consider potential interaction between them. This idea is supported by the research on innovation, which suggests that the development of new products and services results not from individual effort (at the individual level of knowledge) but from creative cooperation (at the social level) (Leonard and Sensiper 1998). Consequently, social capital and human capital are not independent variables; rather, they interact to improve innovative performance.

We argue that high levels of social capital can enhance the skills and capabilities of individuals (human capital). Adler and Kwon (2002) highlight information as being the first direct benefit of social capital. They argued that social capital facilitates access to broader sources of information and improves information's quality, relevance and timeliness. These conditions allow individuals to enhance their knowledge through everyday interactions with colleagues. Similarly, Reed et al. (2006) state that the inimitable value of human capital can be enhanced by social relations. Their argument is that, given competent and credible participants from a diverse set of disciplines, a network of rich social connections (the relational side of social capital) can reduce the amount of time and investment required to gather information and can serve as a valuable conduit for knowledge diffusion and transfer (Burt 1997; Coleman 1998; Reed et al. 2006). McFadyen and Cannella (2004) demonstrate that the strength of a relationship (in terms of the relational side of social capital) can positively affect knowledge creation at the individual level. In summary, individuals' KSA can be more valuable and unique by means of interaction with other colleagues (Loury 1987; Schiff 1992; Putnam 1993; Coleman 1998; Adner and Helfat 2003; Reed et al. 2006). Thus, we state our third hypothesis.

*Hypothesis 3:* The relational side of social capital has a positive effect on human capital.

*Hypothesis 3a:* The relational side of social capital has a positive effect on valuable human capital.

*Hypothesis 3b:* The relational side of social capital has a positive effect on unique human capital.

### ***HRM practices, human capital and social capital***

We have justified the importance of human and social capital for obtaining innovative performance, as well as the potential for social capital to enhance human capital. In this section, we discuss how to enhance both these components of intellectual capital by implementing particular HRM practices.

The 'human capital advantage' described by Boxall (1996) tends to weaken over time. In other words, knowledge, skills and expertise tend to become obsolete. Moreover, managers could encourage high-quality relationships (social capital) to arise spontaneously and could direct them towards the strategic objectives of firms.

As argued by Boxall (1996) and Snell, Youndt and Wright (1996), companies can prevent human capital from becoming obsolete and can stimulate social capital by implementing particular HRM practices. Employing appropriate personnel management procedures, human and social capital can be directed to achieving organizational capabilities by taking into account the value and specificity of employees' knowledge. As a result, this knowledge is updated, improved and disseminated within the organization (Lepak and Snell 1999; Currie and Kerrin 2003).

Particular HRM practices can be recommended for enhancing social capital and for maintaining the value and uniqueness of human capital. However, coherence among these practices is required. Rather than discuss individual and disconnected HRM practices, we focus on three relevant HRM practices with different orientations: staffing procedures, personnel development and use of incentives as a form of compensation (Lepak and Snell 1999, 2002; Gomez-Mejía, Balkin and Cardy 2007).

Staffing practices must be directed to the creation of both human and social capital. In the first case, the orientation of staffing procedures changes depending on the necessity of general versus firm-specific human capital (Sekiguchi 2007). Following Lepak and Snell (1999, 2002), it is appropriate that new employees be selected based more on their potential (e.g. their cognitive capacities, aptitudes and motivation) than on their current knowledge, skills and experience. When such a selection policy is applied, the company is more likely to incorporate into the organization individuals who are capable of learning the valuable and unique knowledge that is necessary for the firm's competitiveness, thereby building human capital that will be advantageous to the company (Subramaniam and Youndt 2005; Sekiguchi 2007). In our case, firms will search for and incorporate employees with learning potential in order to develop valuable and unique knowledge that favours innovation. Thus, we propose the following hypothesis.

*Hypothesis 4:* HRM practices, such as selection processes based on employees' potential to learn, have a positive influence on the value and uniqueness of human capital.

The staffing of employees with valuable and unique human capital is not enough. Companies must incorporate attitudes towards teamwork, interpersonal adaptability and similar criteria into their selection processes in order to improve their social capital (Lengnick-Hall and Lengnick-Hall 2003). In their study of knowledge-intensive firms, Swart and Kinnie (2003) analyse the HRM practices of a software company that develops the social capital for enabling interconnections within the knowledge pool of its employees. Their case study shows how technical ability was not considered the most important element in the selection of candidates and how it was the company's culture that led the recruitment process. Once technically competent candidates were identified, recruits needed to show how they would share their innovative ideas and cutting-edge



know-how within a project team. This kind of practice is expected to affect social capital positively by incorporating into the organization individuals with interpersonal skills and by promoting interaction among individuals (Lepak and Snell 1999). Given the above discussion, we propose the following hypothesis.

*Hypothesis 5:* HRM practices, such as selection processes based on interpersonal skills, have a positive influence on social capital.

Developmental practices such as specific training, career management, mentoring and giving feedback to employees will improve an organization's human capital. As human capital theory has outlined, investment in specific training not only improves individual performance but also encourages career development, which must be facilitated by the firm (Flamholtz and Lacey 1981). Thus, when employees know that their company has training programmes to improve their personal competence, the value and uniqueness of the organization's human capital are enhanced. This is because employees will tend to match their knowledge and skills to the needs of the organization (Shipton, Dawson, West and Patterson 2002). Similarly, when employees are offered career paths within the company, and receive feedback concerning their performance and how it could be improved, valuable and firm-specific knowledge is generated through *internal development*. As discussed above, career expectations contribute to innovative behaviours and enhance human capital (Slagter 2009). Researchers have shown that these developmental practices motivate employees to create opportunities and to improve their personal stocks of knowledge and skills (Ulrich and Lake 1990; Snell and Dean 1994; Lepak, Liao, Chung and Harden 2006). Thus, we try to confirm the following hypothesis.

*Hypothesis 6:* Developmental HRM practices, such as specific training, career management, mentoring programmes and feedback appraisals, have a positive influence on the value and uniqueness of human capital.

Other personnel development practices, such as the delegation of responsibilities and the involvement of employees in decision making, should also be given priority. This is because these practices motivate employees to share their knowledge with colleagues. Implementing this type of HRM practice improves an organization's social capital, thereby strengthening the flow and exchange of information within work groups (Ulrich 1998). Evidence shows that empowerment and employee participation in decision making enable formal and informal work relations that provide employees with a network that they can use for sharing information (Adner and Helfat 2003). Therefore, we can state the following hypothesis.

*Hypothesis 7:* Developmental HRM practices, such as empowerment and employees' participation in decision making, have a positive influence on social capital.

The last set of practices, compensation practices, may also contribute to enhancing human and social capital. Specifically, two issues are important here: the use of individual incentives for new ideas and team-based incentives. Compensation systems are considered especially important when an employer wants employees to acquire the valuable and unique competences considered necessary to a firm's operations (Shaw, Gupta, Mitra and Ledford 2005). Effective compensation systems work to attract and retain the more valuable employees, and to motivate them to develop the required competences (Park, Gardner and Wright 2004). The reasoning is that a company determines the valuable and unique competences that its human resources should possess and decides on the incentives

to encourage their acquisition and development (Cappelli and Singh 1992; Wright, McMahan and McWilliams 1994). Therefore, when employees recognize that they are assessed and then paid according to their contributions over time, in order to develop more valuable and unique contributions, they have an incentive to acquire knowledge that is more valuable to the company and more difficult for competitors to duplicate (Baron and Byrne 1997; Lepak and Snell 1999, 2002). Therefore, we advance the following hypothesis.

*Hypothesis 8:* HRM practices, such as the use of individual compensation incentives, have a positive influence on the value and uniqueness of human capital.

These arguments also apply to teams working on innovations (Sarin and Mahajan 2001). Specifically, Barczak and Wilemon (2003) demonstrate that members of work teams have a strong interest in being remunerated according to the results generated by their teams. Similarly, Laursen (2002) and Laursen and Foss (2003) demonstrate empirically the positive impact of team-based pay on team performance as a motivating tool for sharing knowledge. In summary, the use of group-based incentives may enhance cooperative behaviour and increase interaction among individuals because they perceive that part of their compensation depending on group results (Ulrich and Lake 1990; Snell and Dean 1994; Lepak and Snell 2002). Our next hypothesis is as follows.

*Hypothesis 9:* HRM practices such as the use of team-based incentives in compensation have a positive influence on the firm's social capital.

### ***The contribution of innovation to firm performance***

The final stage of our investigation seeks to learn whether those firms with the appropriate human capital, social capital and HRM practices obtain not only innovations but also a higher performance in the market. According to the literature, innovation is one of the main sources of competitive advantage (Li and Atuahene-Gima 2001). If a company develops innovations based on valuable, rare, inimitable and non-substitutable resources, such as valuable and unique knowledge, they will lead to higher levels of competitive advantage (Barney 1991). Firms that offer new products, adapted to the needs and wants of target customers, are in a better position to obtain higher performance and create sustainable competitive advantage (Prahalad and Hamel 1990; Nonaka and Takeuchi 1995; Alegre et al. 2006).

It has been proposed that the development of an innovation contributes to the performance of a company (Damanpour 1991; Capon, Farley, Lehmann and Hulbert 1992; Pérez-Luño, Valle Cabrera and Wiklund 2007). That is, innovators have the potential to create markets, to shape customer preferences and even to change the basic behaviour of consumers (Zhou 2006), which, in summary, leads to higher profits. From the above, we propose that innovation enhances a company's performance. These assumptions lead us to establish our last hypothesis.

*Hypothesis 10:* Innovative performance is positively associated with a higher level of firm performance.

Figure 1 illustrates the relationships to be tested in this model.

## **Methods**

### ***Population and sample***

The study was carried out in Spain. The criteria for selecting the population were (1) the company is classified as belonging to an innovative sector, (2) the company has at least 50



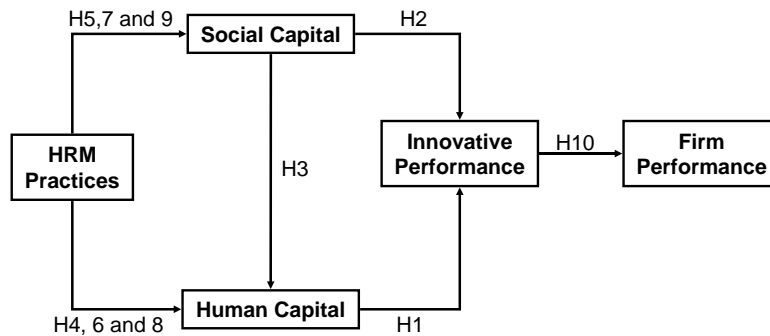


Figure 1. Model of relationships.

employees and (3) the company has an R&D department. The sectors with most patents, according to data from the Spanish Office of Patents, are the following: the manufacture of machinery; the manufacture of motor vehicles; the manufacture of radios, TVs and telecommunications equipment; and the chemicals industry. The DUNS 50,000 database was used to obtain a list of the companies in those sectors with 50 or more employees. A valid total population of 940 companies was obtained by this procedure. We conducted follow-up telephone calls and reviewed company websites to identify the firms with an R&D department. Deleting those without an R&D department yielded our final population of 619 firms.

Our approach involved first contacting companies and then mailing a questionnaire, with follow-ups, as proposed in the literature (Fox, Crask and Kim 1988; Cyciota and Harrison 2001). The unit in which innovation was carried out in each company was identified, and the manager responsible was contacted by telephone; the study was explained, and the manager was notified when the questionnaire had been mailed. To reduce the potential problems associated with single sourcing, following the Huber and Power (1985) guidelines, we selected the person in each organization who had the most knowledge about the variables under study, who was, in this case, the R&D manager.

Initially, a number of companies declined to participate in the study. These companies were not surveyed but were still considered to form part of the total population. Periodic reminders were sent to the companies that delayed completing the questionnaire, and by the end of the fieldwork stage, a total of 85 questionnaires had been completed and returned; this represents 13.73% of the total population. Table 1 presents the technical data sheet for the field-work undertaken.

Table 2 gives that, for each selected sector, the sample and population proportions are similar. The possibility of common method bias was tested using Harman's one-factor test.

Table 1. List of technical details.

Universe	Spanish companies with innovatory activity
Target population	Spanish companies with a department carrying out innovation/R&D
Sample size	$N = 85$ observations
Sample error	$\pm 10.08\%$
Response rate	13.73%
Level of confidence	95.5%
Data collection method	Electronic and postal survey
Date of field study	October–December 2006

Principal components factor analysis on the questionnaire measurement items generated factors with eigenvalues exceeding unity that account for 75.1% of the total variance. Because several factors, rather than one single factor, were identified, and because the first factor accounts for only 12.29% of the variance, the common method variance does not appear to be substantial (Podsakoff and Organ 1986).

### *Measurement of the variables: internal reliability and construct validity*

To smooth out the complex problem of measuring latent or non-observable variables, and because these variables are likely to be related, we apply the methodology used by, among others, Putterill and Rohrer (1995). This involves using measurable surrogate indicators for the unobservable variables. As stated above, the latent variables incorporated into the theoretical model are the value and uniqueness of human capital, social capital, HRM practices, and the innovative performance of the organization, which constitutes the dependent variable. The observable indicators used for these variables are reported in Table 3.

#### *Human capital*

Measurement of the value and uniqueness of human capital is based on the approach of Lepak and Snell (2002). This variable comprises nine items measured on a Likert scale from 1 to 7 (where 1 represents total disagreement and 7 represents total agreement). The first five items measured the value of individual knowledge and skills, and the remaining four items measured the uniqueness of such skills. Cronbach's alpha values of 0.906 and 0.770 indicated that the metrics exhibit both internal reliability and construct validity, respectively; this is because of their unidimensional nature.

#### *Social capital*

The four items representing social capital are based on the work of Nahm, Vonderembse and Koufteros (2003) and Subramaniam and Youndt (2005). These items measured aspects such as the constancy of communication established among managers within their own and other areas, and communication among employees within their area and with other areas. A Likert scale of 1 to 7 (where 1 represents total disagreement and 7 represents total agreement) was used.

The exploratory factor analysis again showed a unidimensional construct (Kaiser–Meyer–Olkin (KMO) = 0.745, with the Bartlett test significant at 99%), and the Cronbach's alpha value was 0.88.

#### *HRM practices*

Measures of HRM practices were adapted from those developed by Lepak and Snell (1999, 2002) in their analysis of human capital architecture. The specific items used were those from their knowledge-based employment model and their collaborative model with respect to collaboration and group works. The reason for this is that both models include HRM practices that have been shown by existing studies to be determinants of human and social capital. Measurement of these variables was based on a scale from 1 to 7 (where 1 represents almost never and 7 represents almost always).

The multidimensionality of the scale of HRM practices was studied. Four factors for HRM practices were obtained. The KMO measure of sampling adequacy was 0.761, and

Table 2. Proportion of sectors in population and sample.

<i>Activity sector</i>	<i>Population</i>	<i>Proportion of sectors in population (%)</i>	<i>Answers</i>	<i>Proportion of answers in sample (%)</i>
Chemical industry	200	32.31	27	31.76
Manufacture of machinery and mechanical equipment	175	28.27	23	27.05
Manufacture of machinery and mechanical equipment (electrical)	92	14.86	12	14.11
Manufacture of electronic equipment; radio, TV and telecommunications equipment	44	7.1	7	8.23
Manufacture of motor vehicles, trailers and semi-trailers	108	17.44	16	18.82
Total	619	100	85	100

the Bartlett test was significant at 99%. The factors extracted explained 68.38% of the total variance of the HRM practices.

An examination of the factorial loadings in the matrix of rotated components allowed us to name each of the principal components obtained. The first principal component, developmental practices, incorporates career options, specific training, mentoring and the assessment of performance with feedback. The second factor incorporates the practices of selection based on learning potential and interpersonal skills. The third principal component combines the practice of compensation-based incentives for both individuals and groups. Although we proposed separate hypotheses for selection criteria and incentives, it seems that the firms in our sample use them jointly. The fourth factor (empowerment) picks up the practice of empowerment. Table 3 provides information on each component.

#### *Innovative performance*

We developed an *innovative performance* scale, based primarily on the Oslo Manual (OECD/Eurostat 1997) and Cabello, Carmona and Valle (2006). It only includes output indicators. The three items selected were 'introduction of technologically new products developed by the company (totally or partially) into the market, frequency of replacement of old products with others that have undergone significant change and proportion of technologically new or improved products in the turnover of the company'. A 7-point scale was used, ranging from (1) for less than the competition to (7) for more than the competition.

Because we use an *ad hoc* measure that is adapted from several existing ones, it is important to study the reliability and validity of the scale. Exploratory factorial analysis based on the method of principal components and varimax rotation showed that the measure is unidimensional; the KMO sampling adequacy index was 0.704, and the Bartlett test was significant at 99%. The Cronbach's alpha coefficient of reliability for the totality of the scale was 0.8, which is above the minimum of 0.7 recommended in the literature (Tabachnick and Fidell 2001).

#### *Firm performance*

Firm performance may be assessed by how effectively the firm functions in achieving a variety of financial benchmarks (an objective measure) or by the firm's position on various

Table 3. Items in the questionnaire and objective measures.

<i>F1: Developmental practices</i>	
Hr10	Training activities that aim to develop firm-specific skills/knowledge.
Hr11	Firm emphasizes promotion from within.
Hr12	Firm emphasizes tutoring and mentoring activities.
Hr13	Firm possesses a socialization programme for newcomers.
Hr14	Performance appraisals include developmental feedback.
Hr15	Performance appraisals emphasize employee learning.
<i>F2: Selection based on learning potential and interpersonal skills</i>	
Hr16	Selection process focuses on selecting the best all-round candidate.
Hr17	Selection process places priority on employee's potential to learn.
Hr18	Selection process assesses the ability to collaborate and work in a team.
<i>F3: Incentives in compensation</i>	
Hr20	Compensation/rewards provide incentives for new ideas.
Hr21	Compensation/rewards have a group-based incentive.
<i>F4: Empowerment practices</i>	
Hr22	Employees perform jobs that empower them to make decisions.
Hr23	Employees participate in the decision-making process.
Hr24	Employees perform jobs that require them to participate in cross-functional teams and networks.
Hr25	Employees perform jobs that involve job rotations.
<i>F5: Innovative performance</i>	
I1	Introduction of technologically new products developed by the company (totally or partially) into the market.
I2	Frequency of replacement of old products with others that have undergone significant change.
I3	Proportion of technologically new or improved products in the turnover of the company.
<i>F6: Value of human capital</i>	
Hr1	Employees have skills that contribute to developing new markets/products/services/opportunities.
Hr2	Employees have skills that create customer value.
Hr3	Employees have skills that are instrumental for creating innovations.
Hr4	Employees have skills that are needed to maintain high-quality products/services.
Hr5	Employees have skills that enable our firm to provide exceptional customer value.
<i>F7: Uniqueness of human capital</i>	
Hr6	Employees have skills that are not available to our competitors.
Hr7	Employees have skills that are developed through on-the-job experience.
Hr8	Employees have skills that are difficult for our competitors to buy from us.
Hr9	Employees have skills that are difficult for our competitors to imitate or duplicate.
<i>F8: Social capital</i>	
Sc1	Constant communication is established among managers within this and other areas.
Sc2	Communication is easily established among employees within this area.
Sc3	Communication is easily established among employees of this and other areas.
<i>Performance: Total sales divided by total assets</i>	
Size: LN. Workers.	

indicators of effectiveness and success relative to competitors' ratings for these indicators (a subjective measure). In our case, we used the objective measure to reduce the common method variance error. That is, we use the ratio of total revenues divided by total assets as an objective measure of profits.

#### *Control variables*

We use size as a control variable. Research has demonstrated that a company's size may be linked to a greater or lesser tendency for innovation (Bantel and Jackson 1989). Some scholars have established that an increase in the size of the organization implies a higher number of resources and higher innovative potential, whereas other scholars have argued that small organizations can be more innovative because they have more flexibility, more ability to adapt and less difficulty in accepting and implementing changes (Damanpour 1991). Following these arguments, we assume that a firm's size has an influence on its innovative activity. The organization size variable was measured by the number of employees in the firm. The value of this variable ranges from 50 to 5000 workers. Because of its wide dispersion, a Napierian logarithm of the number of workers in the firm has been used to estimate this value, in order to avoid the scale effect.

#### *Statistical analysis: the process of validation of the scales*

We used structural equations modelling methodology for the statistical treatment of the data for the measurement model and the structural model. There are two justifications for this. First, using indicators to measure latent variables implies that there are measurement errors. Therefore, we must investigate whether these indicators are valid and reliable representations of the latent variables. Second, given that we wish to analyse simultaneous relationships among latent variables, we must investigate whether the causal relationships specified in the proposed model are consistent with the available data.

Thus, we perform the following checks for the reliability and validity of the scales.

- (1) An analysis of dimensionality.
- (2) An analysis of reliability.
- (3) An analysis of discriminant validity.

To carry out the above checks, we use the statistics program EQS 6.1. Table 4 reports the items retained as suitable indicators for measuring each construct. The table also reports their factorial loadings.

Having presented the results relating to each scale, in Table 5, we report goodness-of-fit indices of the confirmatory factor analysis, which are favourable in all cases.

On the basis of the procedure of Fornell and Larcker (1981), each factor exhibits discriminant validity. For all cases, the mean extracted variances (from the principal diagonal of Table 6) exceed the squares of the correlations between the factors.

## **Results**

Using the EQS software package, we estimated structural equation models to test our hypotheses. Table 7 gives the goodness-of-fit indices of the model. The values of all indicators are within accepted limits (Mueller 1996). Figure 2 illustrates the significant results from the model.

The first set of hypotheses in our article (*H1a*, *H1b* and *H2*) relates human and social capital with innovation. When we analysed such relationships, the only variable that had a

Table 4. Results from the confirmatory factor analysis.

		<i>Factor loading</i>
<i>F1: Developmental practices</i>		
Hr11	Firm emphasizes promotion from within. <sup>a</sup>	0.771
Hr13	Firm possesses a socialization programme for newcomers. <sup>a</sup>	0.659
Hr14	Performance appraisals include developmental feedback. <sup>a</sup>	0.771
Hr15	Performance appraisals emphasize employee learning. <sup>a</sup>	0.81
<i>F2: Selection based on learning potential and interpersonal skills</i>		
Hr17	Selection processes place priority on employees' potential to learn. <sup>a</sup>	0.785
Hr18	Selection process assesses the ability to collaborate and work in a team. <sup>a</sup>	0.761
<i>F3: Incentives on compensation</i>		
Hr20	Compensation/rewards provide incentives for new ideas. <sup>a</sup>	0.646
Hr21	Compensation/rewards have a group-based incentive. <sup>a</sup>	0.811
<i>F4: Empowerment practices</i>		
Hr22	Employees perform jobs that empower them to make decisions. <sup>a</sup>	0.731
Hr23	Employees participate in the decision-making process. <sup>a</sup>	0.321
<i>F5: Innovative performance</i>		
I1	Introduction of technologically new products developed by the company (totally or partially) into the market. <sup>a</sup>	0.807
I2	Frequency of replacement of old products with others that have undergone significant change. <sup>a</sup>	0.683
I3	Proportion of technologically new or improved products in the turnover of the company. <sup>a</sup>	0.787
<i>F6: Value of human capital</i>		
Hr1	Employees have skills that contribute to developing new markets/products/services/ opportunities. <sup>a</sup>	0.821
Hr2	Employees have skills that create customer value. <sup>a</sup>	0.861
Hr3	Employees have skills that are instrumental for creating innovations. <sup>a</sup>	0.868
Hr4	Employees have skills that are needed to maintain high-quality products/services. <sup>a</sup>	0.682
Hr5	Employees have skills that enable our firm to provide exceptional customer value. <sup>a</sup>	0.779
<i>F7: Uniqueness of human capital</i>		
Hr6	Employees have skills that are not available to our competitors. <sup>a</sup>	1
<i>F8: Social capital</i>		
Sc1	Constant communication is established among managers within this and other areas. <sup>a</sup>	0.841
Sc2	Communication is easily established among employees within this area. <sup>a</sup>	0.862
Sc3	Communication is easily established among employees of this and other areas. <sup>a</sup>	0.83

Note: <sup>a</sup>Item remaining after the confirmatory factor analysis.

significant effect on innovative performance was the uniqueness of human capital ( $\beta = 0.244$ ;  $t = 2.594$ ). This supports *H1b* but implies rejection of *H1a* and *H2*.

Hypothesis 3 expects an effect of social capital on human capital. Social capital, significantly and positively, affects the value of human capital ( $\beta = 0.325$ ;  $t = 2.077$ ). When the uniqueness of human capital is used as the dependent variable, the positive



Table 5. Indices of the goodness-of-fit of the confirmatory factor analysis.

<i>Satorra–Bentler chi squared</i>	<i>df</i>	<i>p</i>	<i>BB-NNFI</i>	<i>CFI</i>	<i>RMSEA</i>
252,471	280	0.05451	0.936	0.951	0.044

Notes: Values recommended for the various indices of goodness-of-fit: Satorra–Bentler chi squared with degrees of freedom (*df*) and *p*-value associated with chi squared > 0.05, Bentler–Bonett non-normed fit index  $\geq 0.9$ , comparative fit index  $\geq 0.9$ , root mean square error of approximation  $\leq 0.05$ .

effect of social capital is smaller and less significant ( $\beta = 0.152$ ;  $t = 1.68$ ). These results support *H3*.

A group of hypotheses (*H4* to *H9*) assesses the relationships of certain HRM practices with human and social capital. In this case, developmental HRM practices exert a positive effect on the value of knowledge ( $\beta = 0.375$ ;  $t = 2.670$ ). Empowerment is the only HRM practice to increase significantly the uniqueness of human capital ( $\beta = 0.228$ ;  $t = 2.038$ ). The finding that empowerment practices enhance the uniqueness of human capital was not expected from the theoretical development of this article, but it was an interesting result for discussion. Empowerment and involvement practices also have a significantly positive effect on social capital ( $\beta = 0.421$ ;  $t = 2.799$ ) as does the orientation of selection procedures ( $\beta = 0.475$ ;  $t = 3.811$ ). Staffing practices based on interpersonal skills and learning potential also affect social capital; these selection-procedure variables are included in the same principal component factor, and it was not possible to differentiate them into separate constructs. These results support *H5*, *H6* and *H7*, but they imply rejection of *H4*, *H8* and *H9*.

Finally, innovative activity has a significant positive influence on company performance ( $\beta = 0.357$ ;  $t = 2.638$ ). This result supports our *H10*. We did not find any size effect, as the control variable for number of employees was not significant.

## Discussion and conclusions

We have analysed how human and social capital can contribute to improving the innovative performance of companies, and how social capital might enhance human capital. We have also argued the leveraging effects of HRM practices on human and social capital. Finally, we have proposed a nexus between innovative performance and firm performance. We have empirically analysed these relationships based on data from the R&D departments of a sample of Spanish industrial companies.

Interesting results have been obtained from our research. First, we have obtained evidence that only one of the two characteristics of human capital, uniqueness, has a direct and positive effect on firm innovativeness. That is, it seems that unique and rare knowledge is what gives rise to new products that are different from those of competitors. Nevertheless, contrary to our expectation, valuable human capital has not presented any effect on innovation. This represents a surprising finding, which could be explained in the sense that knowledge value may be a necessary but not sufficient condition for innovation success. That is, if the valuable knowledge were to be equally distributed across organizations (valuable but not specific knowledge), it could hardly generate new ideas and products that would enable organizations to differentiate themselves from each other. This would be the case for the population of workers employed in the R&D units of innovative companies, which are our study sample. They represent valuable knowledge (the necessary condition), but not all of them own unique knowledge. Thus, having employees with highly firm-specific KSA is what enhances a firm's innovative

Table 6. Discriminant validity.

<i>F1</i>	<i>F2</i>	<i>F3</i>	<i>F4</i>	<i>F5</i>	<i>F6</i>	<i>F7</i>	<i>F8</i>
<i>F1</i>	<b>0.5475388</b>						
<i>F2</i>	0.358801	<b>1</b>					
<i>F3</i>	0.423801	0.170569	<b>0.53750856</b>				
<i>F4</i>	0.001521	0.011881	0.010201	<b>1</b>			
<i>F5</i>	0.000729	0.016129	0.0121	0.00112225	<b>0.57920808</b>		
<i>F6</i>	0.198025	0.1089	0.071824	0.000036	0.009216	<b>0.64818248</b>	
<i>F7</i>	0.000025	0.012769	0.006241	0.000625	0.051076	0.005184	<b>1</b>
<i>F8</i>	0.183184	0.214369	0.013689	0.014641	0.007225	0.002601	<b>0.71325926</b>

Table 7. Indices of the goodness-of-fit of the structural model.

<i>Satorra–Bentler chi squared</i>	<i>df</i>	<i>p</i>	<i>BB–NNFI</i>	<i>CFI</i>	<i>RMSEA</i>
248,732	196	0.0631	0.939	0.989	0.025

Notes: Values recommended for the various indices of goodness-of-fit: Satorra–Bentler chi squared with degrees of freedom (df) and *p*-value associated with chi squared > 0.05, Bentler–Bonett non-normed fit index  $\geq 0.9$ , comparative fit index  $\geq 0.9$ , root mean square error of approximation  $\leq 0.05$ .

performance. This distinction among the different effects of both dimensions of human capital on innovative performance is the first contribution of this article to innovation literature.

Second, it seems that social capital does not have, *per se*, a direct influence on innovation. This result does not reduce the importance of social capital for innovation, but it may reflect differently the nature of this influence. In this sense, social capital contributes to the improvement of innovation performance, though not directly but through its positive effect on unique human capital. As has been suggested by Reed et al. (2006), social interaction enables companies more easily to combine knowledge in such a way that the KSA of individuals become more firm specific and idiosyncratic, and thus more difficult for competitors to imitate. That is, our results suggest that human capital plays a mediating role in the relationship between social capital and innovation, whereas other researchers (Subramaniam and Youndt 2005) contend that it is social capital that moderates the relationships between human capital and innovation.

Third, concerning the question of whether HRM practices could reinforce human and social capital, the obtained results confirm that not all the HRM practices do this in a significant way. In particular, we have found that social capital could be enhanced by the selection of individuals with learning potential and interpersonal skills, as well as by their involvement in decision-making processes. These results are consistent with the finding of Swart and Kinnie (2003), who identified the abilities of candidates to collaborate as a key criterion in the selection process for knowledge-intensive firms. These companies need to utilize this kind of selection process in order to ensure interconnections between

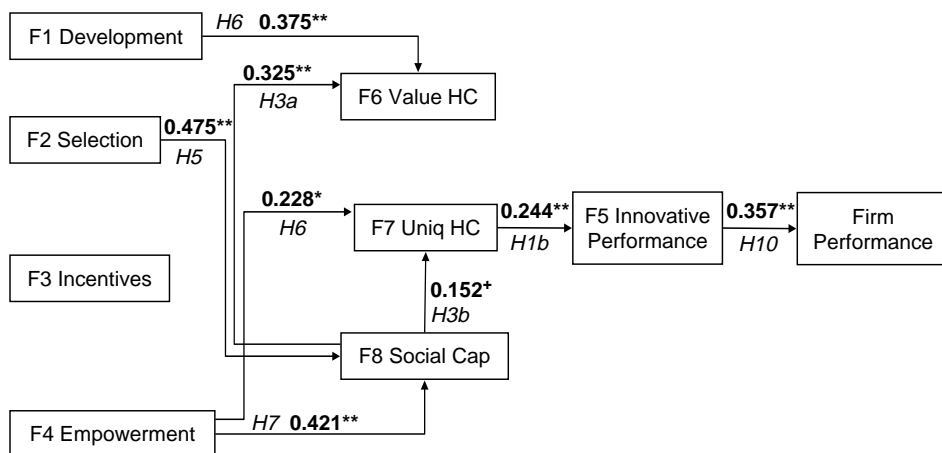


Figure 2. Model of indirect relationships. Notes: \*\*relationship significant at 99%, \*relationship significant at 95%, +relationship significant at 90%.

employees' knowledge and the building of social capital. Similarly, it can be argued that empowerment practices motivate employees to share their knowledge, to increase the exchange of information and to enable informal relationships (social capital).

Fourth, we also found that each dimension of human capital can be enhanced by means of different HRM practices, and this finding represents an interesting contribution to HRM literature. Although developmental practices enhance the value of human capital, empowerment and involvement practices improve its uniqueness. This interesting result suggests that training and career development (developmental practices) would provide individuals with a broader base of knowledge about the organization, increasing knowledge value and favouring internal mobility. Nevertheless, such practices would not lead to deeper knowledge, which seems to be enhanced by empowerment. In this sense, when an employee is empowered, he or she has to find new solutions to concrete issues and internal work problems, which demands higher knowledge levels. Thus, the skills of empowered employees would become more rare and firm specific.

Fifth, contrary to our expectations, we found no evidence that providing individual and group incentives enhances either employee knowledge or team knowledge leading to the promotion of innovation. A possible explanation for this result is provided by Amabile (1998), who argues that innovation requires creativity, which cannot be generated by salary incentives but requires intrinsic compensatory practices. Similarly, Gupta and Singhal (1993) recommend that companies should use promotions and awards, rather than monetary compensation, to reward the creation of new products. Thamhain (2003) also finds that compensation has little impact on innovation by teams. These insights suggest that using compensation to reward innovative *results* rather than innovative *behaviour*, and eschewing non-monetary forms of compensation, diminishes the innovation performance of work teams. Furthermore, because predicting and measuring the results of innovation is difficult, using result-based incentives may not be an effective way of motivating employees to innovate. All of the above considerations help us to understand the role of incentives when the activity results are uncertain, as it occurs in innovation activities. Finally, as we expected, innovative performance had a positive effect on firm performance. This supports arguments in the literature in favour of innovation as a source of competitive advantage.

Despite its contributions, our study has its limitations. First, because the sample size is not sufficient to allow segmentation based on the sectors incorporated in the population, we could not control for sector effects. Second, our measure of innovative performance is based on managerial perceptions rather than on secondary data. This last limitation represents an opportunity for future research.

Interesting implications for HRM in R&D departments emerge from our results. That is, R&D departments should incorporate HRM practices that aim to enhance both the uniqueness of human capital and social capital, which in turn have effects on innovation performance. On the one hand, by means of empowerment, the uniqueness of knowledge can be enhanced, which will directly contribute to improving innovation results. On the other hand, by means of selection processes based on the ability of candidates to collaborate, and by empowerment practices, managers will create conditions favourable to the sharing of information and the building of social capital, which, in turn, will enhance the uniqueness of human capital.

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