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Human resource management systems and their role in the development of strategic resources: empirical evidence

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Abstract *The aim of this paper is double. First, it provides a conceptual framework linking human resource management, organisational learning and knowledge management. Second, the paper builds a causal model and tests it with a sample of firms from the Spanish manufacturing industry, using a structural equation modelling technique. In particular, after the performance of a cluster analysis, a group of 72 learning firms is identified and used to test our model. Finally, major conclusions and implications for management are drawn and further avenues for research are suggested.*

Introduction

This paper is structured into four major sections. The first section develops a conceptual framework for the analysis of the relations among human resource management (HRM) systems, diverse knowledge stocks at different ontological levels and the creation of a long-term competitive advantage. The second section describes the empirical study developed in this research. Using a structural equation modelling (SEM) methodology we analyse causal paths among particular constructs: an internal HRM system, knowledge-based resources at various ontological levels (individual, group and organisational levels respectively) and the creation of a long-term competitive advantage. Third section discusses major results from this empirical research. Finally we synthesise critical conclusions derived from our study as well as we lay avenues for further research.

The aim of this section is to provide a conceptual framework for linking HRM systems, knowledge stocks at different ontological levels (individual, group and organisational level, respectively) and the creation and development of a sustained competitive advantage.

The black box of the firm

Literature on strategic HRM indicates that HRM practices and systems contribute to the creation of a sustained competitive advantage for the firm (Arthur, 1994; Gerhart and Milkovich; Huselid, 1995; Macduffie, 1995; Terpstra and Rozell, 1993).

Those researchers interested in the questionnaire used in this research can contact the author of the paper at patriop@correo.uniovi.es

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However, there is a gap explaining how HRM systems contribute to the creation of a sustained competitive advantage, that is to say, what goes on in the black box of the firm. Although several studies find a positive relation between certain HRM policies or practices and organisational performance, however, literature and most empirical evidence alike do not explain or provide sounding evidence about what happens in the black box between HRM variables and organisational performance (see Figure 1).

On the other hand, literature on the resource and capabilities theory of the firm (Amit and Schoemaker, 1993; Barney, 1991, 1992, 2001; Hamel and Prahalad, 1994; Penrose, 1959; Peteraf, 1993; Priem and Butler, 2001a, b; Teece, 1980; Wernerfelt, 1984, 1995) and the knowledge-based view of the firm (Grant, 1991, 1996a, b; Spender, 1996a, b) alike state that strategic knowledge-based resources contribute to the creation of a sustained competitive advantage. Which resources are strategic? Following Barney's (1991) criteria, those resources which are rare, valuable, non-imitable and without substitutes.

However, these views do not explain how these strategic resources are created, deployed and renewed.

But linking both HRM literature and the resource and capabilities theory of the firm and knowledge-based view of the firm, it may be possible to close the strategic gap and explain what goes on in the black box between HRM systems and organisational performance, that is, how HRM systems contribute to the creation of a sustained competitive advantage using the design of specific HRM policies to build strategic resources.

Given the current recognition among strategic management researchers and practitioners that sustained competitive advantage arises more from a firm's internal resource endowments and deployments that are imperfectly imitable than from the firm's product-market position, an examination of the role that the HR system plays in facilitating or stifling the development of such organisational competencies is warranted (Lado and Wilson, 1994, p. 700).

In particular a HRM system called "make system" can lead to a sustained competitive advantage through the creation of knowledge stocks at individual level, that is, human capital. A make system is comprised by the following HRM practices: comprehensive training efforts (both in terms of training intensity and scope), promotion-from-within, developmental performance appraisal processes and skill-based pay (Arthur, 1992; Pfeffer, 1994; Snell and Dean, 1992; Williamson, 1981).

On the other hand, although time and competition tend to erode the strategic position of human capital, firms maybe able to counteract these natural forces (Lepak and Snell, 1999). The resource-based view of the firm points out that firms can avoid the decay of their knowledge stocks at individual level (human capital) by striving to make knowledge, skills and capabilities more valuable and/or unique. As Lepak and Snell (1999, pp. 43-4) state "to make the deployment and value of human capital more specific, managers logically may try to enhance the uniqueness of human capital by customizing or adjusting skills ... managers may use HR investments to increase the

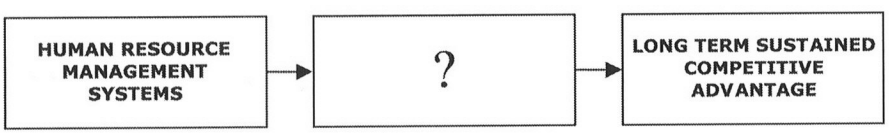


Figure 1.
The black box of the firm

uniqueness of human capital so they might strive to make human capital more valuable".

One way to get these specific knowledge stocks at individual level (human capital) is through an internal HRM system:

H1. A"make" or internal system of HRM is positively associated with the creation of knowledge stocks at individual level (human capital).

An ontological analysis of knowledge stocks in the firm

A stream of research that analyses knowledge stocks in the firm is literature on intellectual capital. Most authors accept that there are knowledge stocks in different ontological lelves: at individual level, at group level and at firm level (Bontis, 1998; Bontis *et al.*, 2000, 2002; Edvinsson and Malone, 1997; Ordóñez de Pablos, 2001a, b, 2002; Roos *et al.*, 1997). Let's describe these knowledge stocks.

First, knowledge stocks at individual level – human capital – represent the knowledge, skills, capabilities, experience and commitment of the employees of the firm (Bontis, 1998; Roos *et al.*, 1997).

Second, most conceptualisation of knowledge stocks at group level – relational capital – consider them as the knowledge embedded in firm's relations both with current and potential customers, suppliers, shareholders, local and national administrations, environment and other agents, that is, knowledge at group level. However, it is clear that the relations of the firm with its employees also create organisational value and for this reason it is necessary to keep them in mind. Thus it is convenient to differentiate between internal knowledge stocks at group level (feedback capital) and external knowledge stocks at group level (feedforward capital) (Ordóñez de Pablos, 2004). Internal stocks include the value of the strategic relationships created between the company and its own employees. External stocks represent the external perspective of the relational capital and include the relationships of the company with key agents for organisational survival: the customers, suppliers, shareholders and stakeholders, both current and potential one, regional and central administrations, and the environment, among others.

Finally, knowledge stocks at firm level – structural capital – represent knowledge that has moved from individuals or the relationships among individuals to be embedded in the organisational structures, like it is the case of the organisational culture, policies, routines or procedures. Bontis *et al.* (2000, p. 88) consider that structural capital "includes all the non-human storehouses of knowledge in organisations which include the database, organizational charts, process manuals, strategies, routines and anything whose value to the company is higher than its material value".

Summarising, human capital, relational capital, organisational and technological capital respectively represent strategic knowledge stocks that can contribute to the creation of a long term competitive advantage. Thus we propose the following research hypotheses:

H2a. Knowledge stocks at individual level (human capital) are positively associated with the creation of a sustained competitive advantage.

H2b. Knowledge stocks at group level are positively associated with the creation of a sustained competitive advantage.

H2b1. Internal knowledge stocks at group level (internal relational capital) are positively associated with the creation of a sustained competitive advantage.

H2b2. External knowledge stocks at group level (external relational capital) are positively associated with the creation of a sustained competitive advantage.

H2c. Organisational knowledge stocks at firm level are positively associated with the creation of a sustained competitive advantage.

H2c1. Technology-based knowledge stocks at firm level (technological capital) are positively associated with the creation of a sustained competitive advantage.

H2c2. Organisational knowledge stocks at firm level (organisational capital) are positively associated with the creation of a sustained competitive advantage.

Empirical research

Methodology and data collection

This empirical study[1] is focused on the Spanish manufacturing industry. The HRM systems, knowledge management and organisational learning questionnaire was developed by the author of this paper. It was was designed in an easy to read booklet format with contained questions covering different areas. Many of the total design method (TDM) recommendations suggested by Dillman (1978) were adopted. The questionnaire was accompanied by a covering letter where the purpose of the survey was fully explained.

The survey questionnaire was administered to 2,136 Spanish industrial firms in 1999 and finally we received 123 valid survey questionnaires. Table I shows technical data of the research (universe, geographic field, data collection method, sample unit, population census, sample size, sample error, confidence level, sample procedure, and time of data collection).

Universe	Firms with 100 or more employees from the Spanish manufacturing industry
Geographic field	National
Data collection method	Postal survey
Sample unit	Human resources directors, knowledge management directors and managing directors
Population census	2,136
Sample size	123
Sample error	8.33 per cent
Confidence level	95 per cent, $Z = 1.96$, $p = q = 0.5$
Sample procedure	The survey questionnaire was sent to the total firm census
Time of data collection	Survey questionnaires were sent late May and early June 2000. Questionnaires were received in June, July, August and September 2000

Table I.
Technical data of the study

The questionnaire used in this research contained statements to which respondents indicated the extent of their agreement on a five-point Likert scale (1 = strongly disagree and 5 = strongly agree) (see "Variable construction" section).

During the pre-test administration, respondents were highly encouraged to ask questions about the purpose of our research and to make sure that the meanings of the questions included in the questionnaire were absolutely clear. All such questions were answered via face-to-face interviews and e-mail or fax. Very few doubts were reported during the pre-test and survey administration.

External validity and internal validity of the sample

External validity condition demands that the sample must be representative of the population. As shown in Table I this requirement is fully satisfied.

Internal validity condition demands appropriate sources of information. In this sense, the cooperation of HR directors, knowledge management officers or managing directors was requested in the covering letter of the survey questionnaire. We got responses from 69 HR directors, 19 chief knowledge officers, 35 managing directors and the rest of the respondents fall under the category of "others" (formation managers, personnel managers and so). All of them are supposed to have adequate knowledge to answer the questionnaire.

Variable construction

Internal HRM system construct

The internal HRM system (IHRMS) was built using an additive index of numerous HRM practices, following the procedures used by Macduffie (1995) and Youndt *et al.* (1996). In particular, 12 items describing HR selection and recruitment process, assessment, rewards and compensation practices were used.

Knowledge stock constructs at different ontological level

The buidling of knowledge stocks variables was based on prior research carried out by Bontis (1998), Bontis *et al.* (2002) and Ordóñez de Pablos (2001a, b).

Thus the construct or variable knowledge stocks at individual level was built with five items that measured features of human capital as described in literature and previous empirical studies. The construct internal knowledge stocks at group level (IKSGL) was constructed with three items that measured features of internal relational capital. The construct external knowledge stocks at group level (EKSGL) was constructed with two items that measured features of external relational capital. The construct technology-based knowledge stocks at firm (TKSFL) level was constructed with three items that measured features of technological capital. Finally the construct organisational knowledge stocks at firm (OKSFL) level was constructed with two items that measured features of organisational capital.

Sustained competitive advantage construct

The sustained competitive advantage variable was constructed with three items that measured ROA, sales increase and organisational performance.

Cluster analysis on knowledge strategies

In order to test the hypothesis set with a sample of firms deeply involved in learning processes, initially we perform a cluster analysis – a methodology that allows us to

extract case typologies with features and behaviours homogeneous inside the cluster but different among clusters. The cluster analysis was carried out using the SPSS for Windows (97) package. In particular, the Ward's hierarchical technique of clustering using squared Euclidean distances was selected. We decided to standardise all variables by using the *Z*-scores so that variables with large units would not be overemphasised.

In line with Bierly and Chakrabarty's study of 21 US pharmaceutical firms, we analysed organisational learning in terms of: internal and external learning process; incremental versus radical or transformational learning; speed of learning; and breadth of organisational learning. The cluster analysis identified several different knowledge strategies among the manufacturing firms. The knowledge strategies for each of the knowledge clusters based on five independent variables are displayed on Table II (Ordóñez de Pablos, 2001a, b, 2002).

In order to study the validity of the application of this technique to the study of the relationship among used variables in the analysis, various indicators that justify the adaptation of the application were calculated: matrix correlation determinant among variables; Bartlett sphericity test = 113.356; significance level = 0.0000; we reject the null hypothesis meaning that the correlation coefficient matrix among items is the identity matrix; KMO = 0.686. All calculated indicators justify the application of the cluster analysis.

Before the interpretation, we synthesise all available information on the three conglomerates. Table III shows mean values and the significance level of the variables.

We labelled the clusters aggressive, loner and exploiter, respectively. Each cluster shows particular features with regard to internal learning, external learning, radical learning, speed of learning and breadth of organisational knowledge base.

Cluster 1 is formed by 72 firms called aggressive. These firms combine high levels of internal and external learning as well as high levels of radical and incremental

Variable	Variation range	Mean	Typical deviation
Internal	(1-5)	3.27	0.94
External	(1-5)	3.22	0.96
Speed	(1-5)	2.70	1.08
Radical	(1-5)	3.17	1.09
Focalisation	(1-5)	3	1.02

Note: $n = 123$

Table II.
Knowledge management strategy for 1995-1999 period

Variable	Cluster 1 ($n = 72$)	Cluster 2 ($n = 36$)	Cluster 3 ($n = 15$)
Internal	3.49	2.67	3.6
External	2.32	2.89	3.47
Radical	3.38	1.81	1.8
Speed	3.75	2	3.27
Focalization	3.03	3.44	3.02

Notes: Values are mean values of variables in each conglomerate. Cluster differences are significant at $p < 0.01$

Table III.
Conglomerate description (cluster mean variable values)

learning – more prone to radical learning than incremental learning. Additionally their learning speed is very high and its knowledge base is broad. Cluster 2 is formed by 36 firms labelled loners. Their levels of internal learning, external learning and organizational learning speed are below average. In sum, there are the least efficient firms regarding organisational learning. Furthermore, the breadth of their organisational knowledge base is too narrow, showing a very focalised organisational learning. Finally, Cluster 3 – called exploiters – is formed by 15 firms. Exploiter firms have low levels of internal learning and high levels of external learning. They are focused on incremental learning rather than radical learning. As a result of their exploitation of different types of organisational knowledge, their knowledge base is very broad.

As Cluster 1 was deeply committed with learning strategies, this cluster was used as a sub-sample to test our set of hypotheses (see Figure 2).

Test of hypotheses

As indicated previously, the aim of this research is to investigate two major issues. First, we examine the impact of a particular HRM system on the creation/acquisition, development and deployment of knowledge stocks at individual level. And second, the influence of various knowledge stocks at different ontological levels (individual, group and organisational level, respectively) on the creation of a sustained competitive advantage is analysed. Figure 3 summarises the six hypotheses of our model.

SEM technique

In the literature on SEM, the best-known causal modelling technique is LISREL (Jöreskog and Sörbom, 1989). However, LISREL is poorly suited to deal with small data samples (Fornell, 1982; Fornell and Bookstein, 1982). In order to avoid some limitations exhibited by LISREL, an alternative causal modelling technique called partial least squares (PLS) was developed. In contrast with LISREL-type models, strategic management research presents a low familiarity with PLS-type models.

PLS technique is used in a wide range of management areas such as studies of cooperative ventures (Fornell *et al.*, 1990), global strategy (Johansson and Yip, 1994),

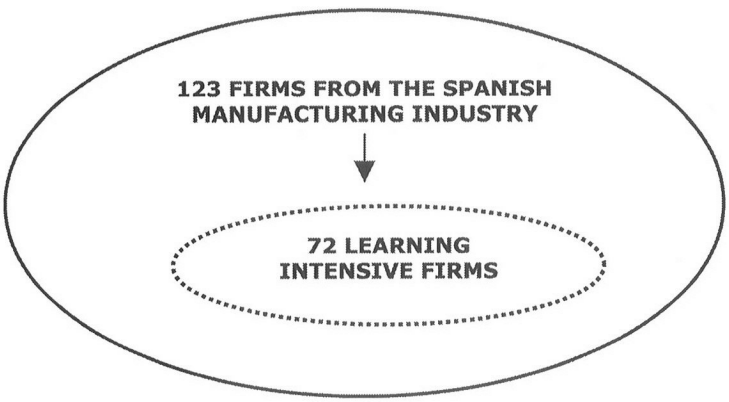
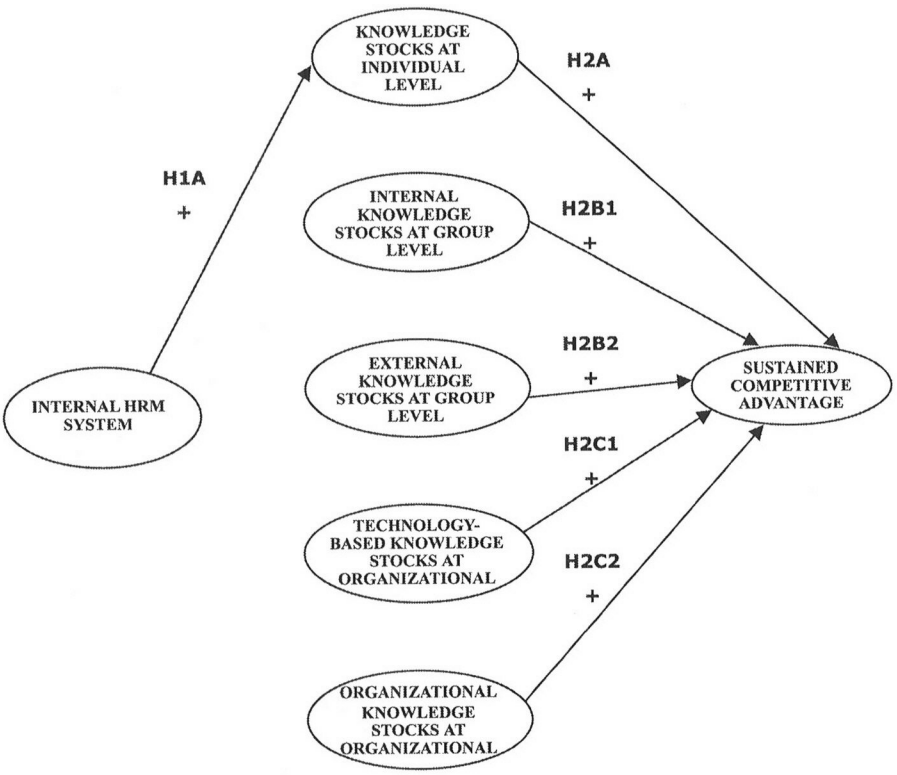


Figure 2.
Subsample integrated by 72 learning-intensive firms



Note: Model tested with a subsample of 72 firms classified as "learning intensive firms"

Figure 3.
HRM system-knowledge stocks-sustained competitive advantage model in learning intensive firms

global integration (Birkinshaw *et al.*, 1995), and organisational learning and intellectual capital (Bontis, 1999; Bontis *et al.*, 2000).

As Hulland (1999) suggests, the process of model specification begins by considering the theoretical model underlying a particular research. The causal modelling process begins at conceptual level. Later, three general methodological considerations relevant to the application of PLS in a management research context should be considered: assessing the reliability and validity of measures, determining the appropriate nature of the relationships between measures and constructs and finally interpreting path coefficients as well as determining model adequacy.

Generally a PLS-type model is analysed and interpreted sequentially in two steps (Chin, 1998). The first stage focuses on the assessment of reliability and validity of the measurement model. The second stage deals with the assessment of the structural model.

In order to assess the measurement model, we must examine individual item reliabilities, convergent validity and discriminant validity. In PLS-type models, individual item reliability is assessed by examining simple correlations or loadings. A rule of thumb is to accept items with loading of 0.7 or more. Its means that there is more shared variance between the construct and its measure than error variance.

In PLS, convergent validity is generally reported using the internal consistency measure developed by Fornell and Larcker (1981).

Finally, discriminant validity represents the extent to which measures of a given constructs differ from measures of other constructs in the same model (Hulland, 1999). In order to assess discriminant validity, Fornell and Larcker (1981) propose the use of the average variance shared between a construct and its measures (AVE).

Additionally a jack-knife analysis was also performed using a program developed by Fornell and Barclay (1983). Jack-knifing allows the testing of the significance of parameter estimates from data which are not assumed to be multivariate normal.

Model goodness-of-fit

There is an important difference in objectives between LISREL and PLS. As Hulland (1999, p. 202) states:

> LISREL and other covariance structure analysis modelling approaches involve parameter estimation procedures which seek to reproduce as closely as possible the observed covariance matrix. In contrast, PLS has as primary objective the minimization of error (or, equivalently, the maximization of variance explained) in all endogenous constructs. The degree to which a particular PLS model accomplishes this objective can be determined by examining the R^2 values for the dependent (endogenous) construct.

As a result of this, there is no overall goodness-of-fit measure for models estimated using PLS technique. Several authors (Hulland, 1999) propose that researchers using PLS-type models should report R^2 values for the endogenous constructs of their models.

Discriminant validity was assessed using EVA value. All values are appropriate for PLS: 0.7308 for knowledge stocks at individual level, 0.5890 for internal knowledge stocks at group level, 0.7162 for external knowledge stocks at group level, 0.6024 for technology-based stocks at firm level, 0,549 for organisational knowledge stocks at firm level, and 0.8449 for sustained competitive advantage.

In this study the sample size of 72 respondents is high enough for PLS. As Hulland (1999) states, one of the key benefits of using PLS is that it may work with smaller samples. In general, the most complex regression will involve:

- the indicators on the most complex formative construct; or
- the largest number of antecedent constructs leading to an endogenous construct.

Sample size requirements become at least ten times the number of predictors from either of the above, whichever is greater (Barclay *et al.*, 1995).

The face of validity of measures was assessed by examining the loading (simple correlations) of measures with their respective construct. A rule of thumb is to accept items with loading of 0.7 or more, which implies more shared variance between the construct and its measures than error variance (Carmines and Zeller, 1979). All of the remaining items have loadings over the 0.7 threshold (see Table IV).

Now let's analyse the results of the paths analysis of the model (see also Table V):

- *H1* tested the relationship between an internal system of HRM and knowledge stocks at individual level. As shown in Table V, the results indicate a positive and significant path coefficient of 0.407 ($p < 0.01$), thereby providing support for *H2a*.

	Loadings
Knowledge stocks at individual level	
KSIL-1	0.5727
KSIL-2	0.6597
KSIL-3	0.7620
KSIL-4	0.8012
KSIL-5	0.7571
Technology-based knowledge stocks at organisational level	
TSKFL-1	0.7252
TKSFL-2	0.8580
TKSFL-3	0.6250
Internal knowledge stocks at group level	
IKSGL-1	0.7495
IKSGL-2	0.7574
IKSGL-3	0.7783
Organisational knowledge stocks at organizational level	
OSKFL-1	0.8724
OSKFL-2	0.7022
External knowledge stocks at group level	
EKSGL-1	0.7560
EKSGL-2	0.7682
Sustained competitive advantage	
SCA-1	0.6833
SCA-2	0.8875
SCA-3	0.8618
SCA-4	0.8603
SCA-5	0.8557

Table IV.
Loadings

Hypotheses and paths	Predicted sign	Path coefficient	*t*-stat.
Internal HRMS → knowledge stocks at individual level	+	0.407	5.6619**
Knowledge stocks at individual level → sustained competitive advantage	+	0.256	2.2557*
Internal knowledge stocks at group level → sustained competitive advantage	+	0.356	1.9796
External knowledge stocks at group level → sustained competitive advantage	+	0.199	1.7909
Technology-based knowledge stocks at firm level → sustained competitive advantage	+	0.256	2.2557*
Organisational knowledge stocks at firm level → sustained competitive advantage	+	0.316	1.6796

Notes: * $p < 0.05$; ** $p < 0.01$

Table V.
Path coefficients

- *H2b* tested the relationship between knowledge stocks at individual level and the creation of a sustained competitive advantage. The results show a positive, substantive and significant path coefficient of 0.256 ($p < 0.05$).
- *H2b* tested the relationship between various knowledge stocks at group level and sustained competitive advantage. This general hypothesis is formed by two

sub-hypotheses. *H2b1* analyses the causal relation between internal knowledge stocks at group level and a long-term competitive advantage. *H2b2* studies the relation between external knowledge stocks at group level and a sustained competitive advantage. Even though both path coefficients are positive (0.356 for the first path and 0.199 for the second one), they are not significant.

- *H2c* tested the relationship between organisational knowledge stocks at firm level and sustained competitive advantage. This hypothesis is formed by two sub-hypothesis. The first sub-hypothesis studies the impact of technology-based knowledge stocks at organisational level (technological capital) on the creation of a sustained competitive advantage. The second sub-hypothesis analyses the causal relation between organisational knowledge stocks at firm level and the creation of a long term sustained competitive advantage. As indicated in Table V, the first path coefficient has a value of 0.256 which is positive and significant ($p < 0.01$). The path coefficient for the relation between organisational knowledge stocks at firm level and organisational performance is also positive but not significant.

Finally, the R^2 for knowledge stocks at individual level contruct and sustained competitive advantage is respectively 31.62 per cent and 25.33 per cent (see Table VI).

Discussion of empirical evidence

Let's address the discussion of the results considering the two sets of hypothesis of the causal model.

The first set of hypotheses deals with the direct relationship between a particular HRM practice system and knowledge stocks at individual level. Empirical evidence supports this hypothesis (*H1*). An IHRMS is focused on the internal development of knowledge stocks at individual level. It contributes to the creation of a sustained competitive advantage enabling firms to decrease overhead and administrative costs, balance work requirements (Pfeffer, 1994) and enhance organisational flexibility (Miles and Snow, 1992).

The second set of hypotheses encompasses the link between knowledge stocks at different ontological levels and the creation of a long term competitive advantage. In particular, it addresses the relationship between knowledge stocks and organisational performance.

Only two of the hypotheses linking knowledge stocks with a sustained competitive advantage are supported by empirical evidence. First, human capital, that is, knowledge stocks at individual level has a direct, positive and significant relationship with the creation of a sustained competitive advantage. Human capital leads to an increase in customer benefits by affording organisational the flexibility required to meet the changing customer needs as well as providing them with the innovative spark needed to achieve leadership in the market.

Table VI.
Predictive power

Construct	R^2 (%)
Knowledge stocks at individual level	31.68
Sustained competitive advantage	25.33

Second, technology-based knowledge stocks at firm level (*H2c1*) have a positive and significative relationship with the creation of a long term competitive advantage for the company. As proposed by certain authors (Edvinsson and Malone, 1997; Roos *et al.*, 1997), this knowledge embedded in organisational structures is essential for protecting the firm in case a key employee decides to leave the firm.

On the other hand, empirical evidence shows that knowledge stocks at individual and group levels respectively have a positive relationship with organisational performance but this relation is not significant. Does this fact mean that the firm should not "invest" in these types of knowledge stocks? Clearly the answer is "no". Literature on knowledge management and organisational learning addresses the continuous interaction of knowledge flows both intra and interorganisationally. In particular, Nonaka and Takeuchi (1995) propose a model called "spiral of knowledge creation" in order to explain how knowledge stocks at individual level can be transformed into knowledge stocks at group and organisational level. They say that through the interaction of tacit and explicit knowledge, four knowledge conversion processes take place: socialization, externalisation, combination and internalisation. This spiral moves from individual level towards organisational or interorganisational level, finalizing the first knowledge creation spiral by generating embedded knowledge, that is to say, structural knowledge.

Therefore, following the model proposed by Nonaka and Takeuchi (1995), the firm may attempt to transform knowledge stocks at group level and organisational knowledge stocks at firm level in other type of knowledge stocks that lead to the creation of a sustained competitive advantage.

Conclusions

The conceptual framework developed in the first section of this paper establishes a link between HRMS, strategic organisational resources and the creation of a sustained competitive advantage.

On the one hand, literature on HRM proposes that HRM systems can contribute to the creation of a long term competitive advantage. However this literature does not address the "how question" (Youndt and Snell, 1998; Youndt *et al.*, 1996). On the other hand, resource and capacities theory of the firm and knowledge-based view of the firm consider knowledge-based resources as key elements for the achievement of a long term competitive advantage, as they fully meet the conditions proposed by Barney (1991): rare, valuable, non imitable and without substitutes.

Linking both fields of research, we argued that HRM systems may led to a sustained competitive advantage through the creation and deployment of knowledge-based resources.

The second section of this paper presents the empirical study developed to test our hypotheses. Using the survey methodology, we built a sample of 123 firms from the Spanish manufacturing industry. All firms had more than 100 employees. Initially we performed a cluster analysis and found out 72 that could be descibed as "learning intensive firms", that is, they exhibit high levels of internal learning, external learning, radical learning and high speed of learning.

With this sub-sample, we tested our causal model using structural causal methodology (SEM). In particular, we used the covariance approach to this metholology and used the PLS-GRAPH software developed by Wynne Chin (1998).

The test of our hypotheses reveals that an internal HRM system contributes to the creation of knowledge stocks at individual level, that is, human capital. Regarding the second set of hypotheses, only two hypothesis are valid (*H2a* and *H2c1*), that is, the positive and significant link between knowledge stocks and individual level (human capital) and technology-based knowledge stocks at firm level respectively (technological capital) and the creation of a sustained competitive advantage. All other paths of the causal model are positive but not significant.

Avenues for further research

The next phase of this research will extend the developed model to analyse more complex interrelationships among the constructs. In particular we will examine causal interactions among various knowledge stocks at different organisational levels in order to study the conversion of knowledge in the knowledge creation spiral.

Additionally we will also study the impact of a HRM systems called "buy system" in order to acquire human capital and compare results with the "make system" of HRM.

Note

1. This empirical study is based on theory and partial data from a major research focused on intellectual capital, HRM systems and organizational performance in the Spanish manufacturing industry during the period 1995-1999. It is integrated in the author's own doctoral dissertation.

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