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The impact of structural capital on the firm Innovativeness, the Galician Northern Portugal automotive industries reality

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1. Introduction

Nowadays, on the knowledge-based economy, intangible assets are seen as essential elements to value creation in companies, on the other hand, survival of companies depend on their capacity to innovate. On this line, the source of economic value and wealth is the creation and management of intangible assets, frequently grouped under the generic term “knowledge”, “intangibles”, or “intellectual capital”(Lev, 2001). Reed et al. (2006) propose the "vision of the company based on intellectual capital (IC-based view of the firm), plus focused and less general than the aforementioned theory of resources and capabilities. This proposal presents a study of organizations focused on their stocks and flows of knowledge, analyzed from the perspective of the different dimensions of intellectual capital.

Although some attempts to measure intellectual capital have been made so far, there is still a long way to go. Intangibles and intellectual capital have become a major issue not only for academics, but also for governments, regulators, enterprises, investors and other stakeholders during the last decade. The intellectual capital is increasingly considered a source of competitive advantage. Some firms have created a superior competitive advantage throughout a superior and unique ownership of critical intangible resources, namely, intellectual capital. While much research attention has focused on understanding how knowledge is created and distributed, little is known about performance enhancement offered by intellectual capital. The intellectual capital is the firm capacity to transform knowledge and intangible assets in wealth, building resources (Edvinsson, 2002), so it can be viewed as source of sustainable competitively.

There have been made recent efforts to link intellectual capital and innovation (as a source of competitive advantage), some authors argue that intellectual capital is an innovation input (Ahuja, 2000; Cohen & Levinthal, 1990; Nahapiet & Ghoshal, 2002; Nonaka & Takeuchi, 1995; M. Subramaniam & Youndt, 2005; Tsai & Ghoshal, 1998) others considerer that innovation is a result of the intellectual capital (Ahuja, 2000; Cohen & Levinthal, 1990; Nahapiet & Ghoshal, 2002; Nonaka & Takeuchi, 1995; Santos Rodrigues, 2008; M. Subramaniam & Youndt, 2005; Tsai & Ghoshal, 1998), or that the different innovative capacities vary on the type of knowledge needed (Cardinal, 2001).

Chen et al. (2006) analysed the influence of intellectual capital in the innovative competence of the companies, and found that the three dimensions of intellectual capital considered (human capital, structural capital and relational capital) have a significant positive correlation with the innovative efforts of the firms. Wu et al. (2008) conducted a similar study analysing

how some organizational features can enhance the relationship between intellectual capital and innovation. Nevertheless, the interest showed on the innovativeness of the firm and the factors that influence on it, there has been little results about this liaison (Wan, Ong, & Lee, 2005). Because intellectual capital and innovativeness are becoming more tightly couple over time, more conceptual and empirical work need to be build on. While the extant research is mainly theoretical, additional inquiry is warranted to provide a more holistic view of intellectual capital and how it affects firm performance. Accordingly, our paper attempt to help to close the gap between intellectual capital and the innovativeness of the firm, in that sense we focus on impact of the structural capital on the innovativeness of the company.

The main objective of this study is to verify whether the structural capital influence the firm innovativeness. Therefore, our research question is:

Does the structural capital influence the innovativeness of the company?

The structure of this article will be the following, after the introduction, the bibliographical review is presented addressing the conceptualization of structural capital and innovativeness. Based on this bibliographical review, the research hypotheses to be subsequently tested are formulated. Next, the research method adopted is described. Then, the data collected are analyzed and the research hypothesis is tested. Final conclusions are presented and future research steps are recommended to assist in testing the exploratory propositions formulated in this work.

2. Literature review

The research interest on intellectual capital has been growing fast in later years, especially in firms were benefits derive majority from innovation and knowledge intensive services (Edvinsson & Sullivan, 1996). The literature consider that firms with superior intellectual resources understand, better than the competitors, how to explore, deploy, combine and configure resources and capacities on a distinct way, that gives to clients more value than the competitors (Spender & Marr, 2005; Teece, Pisano, & Shuen, 1997).

Innovation that may serve as the basis for competitive advantage (Khazanchi, Lewis, & Boyer, 2007), is strongly linked to knowledge (McGrath, 2001; Peng, Schroeder, & Shah, 2008). Therefore, the alignment of knowledge, as an intangible resource, with the innovation strategy could enhance performance and culminate in a competitive advantage (Robert M Grant, 1996; Robert M. Grant, 1996).

Intellectual capital of a company is defined as all non-monetary and non-physical resources that are fully or partly controlled by the organisation and that contribute to the value creation of the organisation (G. Roos, Pike, & Fernström, 2005). There's no consensus about the categorization of the different strategic knowledge assets. Even though the debate about the components of the Intellectual Capital is still partially open, the Intellectual Capital components, recognized and mainly accepted in most of the literature, are human capital; structural capital and relational capital.

Literature describes the Structural Capital as the collective knowledge and expertise (I.A.D.E., 2003). Structural capital is the knowledge owned by the organization that is, or have a, resident status, since it remains in the organization regardless of the remaining people. Knowledge is embedded in the routines of the company, mechanisms and structures that support employees in their search of intellectual performance, is the knowledge, skills, experiences and information, institutionalized, codified and used by databases, patents, manuals, structures, systems, routines and processes.

It can, therefore, be included in this dimension all nonhuman intangibles of the organization, ie, can be considered within the Capital Structure the culture, internal processes, information systems or databases (N. Bontis, Keow, & Richardson, 2000).

Most papers do not directly analyse the effect of capital structure on innovation, but some of the aspects that comprise it. For instance, Rouse and Daellenbach (1999) consider that sustainable advantage is driven by culture, there is evidence of a correlation between corporate culture and innovative performance (Neely & Hii, 1999). The culture can be developed to foster innovation and learning (Denisi, Hitt, & Jackson, 2003). A business culture that encourages risk (Wan, et al., 2005) and encourages the development of new ideas, supporting innovation supports controlled error (Farson & Keyes, 2002). Companies have a culture which supports and rewards innovation should be identified in the culture is what gives competitive advantage (Nick Bontis & Fitz-enz, 2002). For employees to be motivated to innovate must have a culture that supports and rewards innovation (Wan, et al., 2005). More effective culture for knowledge creation is the one that bears the identification of people with the company, trust and sense of efficacy (Sveiby & Simons, 2002).

Managers who see the company with these characteristics at her as highly innovative and feel good and motivated to undertake innovative projects and risk (N. Subramaniam & Ashkanasy, 2001). So, consciously, unconsciously, company culture is a reflection of the leader, or manager (Jassawalla & Sashittal, 2003).

The innovative firm is one that has implemented an innovation (product, process, marketing or organisational innovation) during the period under review (OCDE/UE, 2005). Roos et al. (J. Roos, Roos, Dragonetti, & Edvinsson, 1997: 39) define innovation as an intellectual agility, tightly linked to competence; the ability to use knowledge and skills; the ability to build on previous knowledge and generate new knowledge. That means that the innovativeness involves the creation of new knowledge, or a novel recombination of existing knowledge. Organizations without the capacity to innovate may invest time and resources in studying markets but are unable to translate this knowledge into practice. In this line, Innovativeness relates to the firm's capacity to engage in innovation; that is, the introduction of new processes, products, management or market ideas in the organization. This capacity to innovate is among the most important factors that impact on business performance. Under market turbulent conditions, the firm's innovativeness is particularly important to satisfy the evolving market needs.

An innovation “*is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations*” (OCDE/UE, 2005: 33). So, the innovative firm is one that has implemented an innovation (product, process, marketing or organisational innovation) during the period under review (OCDE/UE, 2005).

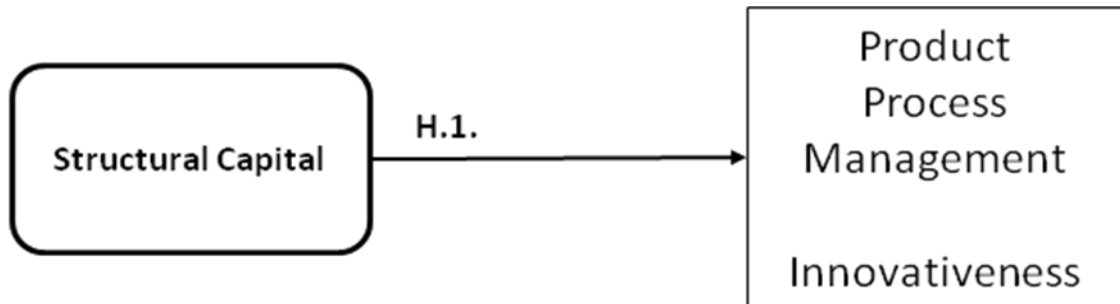
3. Hypothesis

Knowledge assets of enterprises are positively related to their level of innovation (Thornhill, 2006). So, to create new or better products, firms must reallocate resources, combine new resources or combine existing resources both inside and outside firms in new ways (Tsai & Ghoshal, 1998). Thus, we predict the following hypothesis:

H₁: Structural capital is positively related with the innovativeness of the company.

Hereby we predict the influence of structural capital on the main innovation outputs, the product, process and management innovation. Figure 1 display our hypothesised relationship between the structural capital and the tree types of innovativeness considered.

Figure 1: hypothesis



4. Methods

4.1 Sample and data collection

We tested the hypothesis using a survey data collected in 2007 from companies registered on the main and most representative associations of the automotive sector in Galicia (Spain) and North Portugal. Those associations that meet the requirements were “Fundación Clúster de Empresas de Automoción de Galicia” (CEAGA) in representation of the northern Spain (Galicia) firms, plus the “Associação de Fabricantes de Industria Automóvel” (AFIA) as representative of companies in North Portugal.

We targeted 135 companies, 66 from Galicia and 69 from the northern of Portugal. While obtaining a sample of significant linkage of the intellectual capital as a strategic resource and its effect on the innovativeness would allow more comprehensive understanding of the phenomenon, we relied on upper managers as key expert informants—an established practice in organizational research (Huber & Power, 1985) and because they are those whom are aware of the strategic choices.

The survey was constructed in Portuguese and Spanish, while the firms were in two different countries. To assure the language consistency of the survey it was tested with some scholars and specialists of the sector. The data collection took place in June 2007 via regular mail to 135 companies. Each participation request included a description of the study, a statement of confidentiality, and a way back envelope pre-stamped.

We received 68 responses, for a response rate of 50.37% percent. Of the responses, 45 came from the Galicia firms, while 23 were obtained from the Portuguese firms. Of the 68 firms responding, we were able to obtain archival performance data equivalent, thus 68 was our effective sample size.

4.2 Measures

Both intellectual capital components and the innovativeness have been regarded as multidimensional constructs. This implies the need to establish a series of items to measure

them together. As there aren't valid and tested scales due Intellectual capital, as well as innovativeness, we have developed new scales for structural capital and innovativeness.

We considered that the main structural capital dimensions relevant to the company innovativeness were:

We considered that the main structural capital dimensions relevant to the company innovativeness were:

- "culture" (I.A.D.E., 2003; Jassawalla & Sashittal, 2003; N. Subramaniam & Ashkanasy, 2001) (Schneider, 2000; M. Subramaniam & Youndt, 2005; Youndt & Snell, 2004), reflects the existence of an innovation-oriented department in the company, as well as processes designed to foster innovation or a collection system and implementing new ideas,
- "trust" (Galdford & Drapeau, 2003; Jassawalla & Sashittal, 2003) between employees and the confidence they have on the company and its management. It also includes the environment of confidence in the company and the role played by the leader in the enterprise, so call this factor "Trust".
- "Firm characteristics" (Subramanian & Nilakanta, 1996; Wan, et al., 2005), reflects the formalization of the company, as the existence of job descriptions, centralization and the structural characteristics of the company.
- "Creation and Knowledge Development" (I.A.D.E., 2003; Shelton, Davila, & Brown, 2005), includes institutional support to the creation of knowledge through the existence of groups of valid improvements and use of employee suggestions well as opening the willing to innovative in processes or suggest improvements.

We relied on three performance measures of the innovativeness: the product, process and management innovation

(Ahuja, 2000; Davenport, Prusak, & Wilson, 2003; Hii & Neely, 2000) (Ravichandran, 2000). On our analysis we considered the relative innovation, meaning that an innovation is considered new if it is new to the company, and nevertheless it isn't new to the world or industry.

To evaluate the different constructs we will use the principal components technique. This technique aim to reduce the size of the initial set of items that provide common information seeking to praise them all and create some new variables which collect common information, remaining the residual and more specific information for each of the original items. The

variables with communalities less than 0.4 were analyzed to be eliminated as they don't contain information common to the rest of items. To select the number of factors we take into account the Kaiser method, the scree plot and those that explain at least 50% of the total variance (Costelo & Osborne, 2005).

Having reduced the information to better understand its meaning, we make use of a rotation process of adjusting to the different axes original items so no information is lost. Traditionally, it uses a technique that maintains varimax orthogonal relationship between the components involved, ensuring uncorrelated.

The degree of validity of this technique is given by two auxiliary instruments: Bartlett test and the coefficient of Kaiser-Meyer and Okin (KMO). The first tested whether the correlation matrix between the original items is an identity matrix, i.e. there is no common information between these items and, therefore, cannot find that information. That means that we find this significant test would indicate that there is common information among the items analyzed.

The second instrument will measure sampling adequacy by comparing the partial correlation between the items involved. If that ratio is close to 1 is an indicator that the partial correlations are almost zero and therefore the information items is included in the set of all of them, i.e. the specifications of each item are small in relation to all. The values that are usually considered acceptable are those older than 0.6.

For the analysis process, purification and processing of data, determining factors and impact assessment we used the Statistical Package for the Social Sciences (SPSS version 15). The results are shown in Table 1 and 2.

Table 1: Structural Capital Component Matrix

	Component		
	1	2	3
Our employees trust on the organization	,823	,058	,197
Our partners rely on the company's functional directors	,797	,201	,057
There is a high degree of trust between the people of our company	,758	,220	,018
Our employees trust on the people who make strategic decisions	,681	,127	,172
Our company has a work environment that encourages the active participation of people in the company's innovation	,599	,459	,051
All employees are viewed as "peers"	,592	,225	,242
Our employees are hired and trained to perform a specific task in a specific department.	,563	,045	,003
I see our company as innovative, that encourage new experiments and to take risks	,521	,062	,335
Most business decisions must be approved by senior	,513	-,287	,411

	Component		
	1	2	3
management			
We managed to extract value from the innovation process	,497	,295	,474
Consciously or unconsciously, the culture of our company is the reflection of the leader, or manager	,345	,245	,161
Our employees make innovative suggestions	,083	,810	,257
There are groups of improvements that facilitate business innovation	-,064	,691	,357
Our employees are open to reveal their true thoughts and ideas and innovative solutions through formal and informal interactions with other members	,310	,672	,053
Our employees enjoy participating in creative discussions	,352	,655	,022
The suggestions made by employees are mostly implemented	,150	,654	,295
We use detailed descriptions of the work (job descriptions), procedures and policies to guide the actions of employees	-,064	,307	,821
In our company there is innovation-oriented department (R & D, Quality, or other)	,216	,090	,710
Our company has a set of processes and procedures focused on promoting learning and innovation	,386	,313	,663
Our company has a good collection and implementation system of new ideas	,162	,466	,611

Table 2: Innovativeness Component Matrix

	Component	
	1	2
Our company introduce many management or administration innovations of significant importance	,916	,005
In our company we introduce important management innovations that would improve the profits of the enterprise	,858	-,001
Our company introduced many product innovations in the market of significant importance	-,162	,768
The importance of new products in total sales has increased substantially in recent years	-,016	,738
Our company developed and introduced many innovations in the production process of significant importance	,474	,701
The process innovations introduced were critical to reducing costs or other improvements	,491	,600

Since the set of items used for each aspect, trying to measure a single construct, to establish the reliability of the measuring instrument and data collection, we calculated the Cronbach alpha coefficient, through which it was determined Internal consistency of the questionnaire. This method is based on the analysis of the average correlations among items related to one theme, from a single administration of the questionnaire. This ratio produces values ranging from zero (0) and one (1). The closer the value one (1), more reliable is the instrument. The

criteria used for the interpretation of the Cronbach alpha coefficient is if it is less than 0.6 (low), between 0.61 and 0.70 (right), ranging from 0.71 to 0, 80 (good), over 0.80 (high).

Table 3: Initial model constructs

Constructs	N° ítems	α de Cronbach
Structural Capital (SC)	20	,901
Innovativeness (CI)	6	,688

We verify a discrepancy between the initial group of items and the resultant principal components factor analysis Table 4.

Table 4: Construct analysis

Constructs		Var. acum. Expl. (%)	KMO	Bartlett's test	
Structural Capital	Innovative culture Trust Creation and Knowledge Development	55,812	,759	Chi2= 701,727	Sig. 0.000
Innovativeness	Product -process innovation Management innovation	67,562	0,536	Chi2= 150,872	Sig. 0,000

Factorial analysis of principal components was that the 20 initial variables are explained in 55.812% for 3 common factors obtained from Varimax rotation with Kaiser Normalization converged in 8 interactions.

- The first factor we call the "Innovative Culture", reflects the existence of an innovation-oriented department in the company, as well as processes designed to foster innovation or a collection system and implementing new ideas.
- The second is "trust" between employees and the confidence they have on the company and its management. It also includes the confidence environment of the company and the role played by the leader in the enterprise. So we call this factor "Trust".
- The third factor is "Knowledge Creation and Development, it includes institutional support to the creation of knowledge through the existence of improvement groups and use of employee suggestions well as opening individuals to innovative processes or suggest improvements.

The KMO indicates a reasonable correlation between the items (KMO = 0.759) and the test of Bartlett's has an associated level of significance of 0.000 which leads to the rejection of the hypothesis that the correlation matrix is the identity matrix ($p < 0,01$), then there is a correlation between some variables. Both tests allow the continuation of factor analysis.

The component matrix shows that the 6 initial items are explained in 67.562% for 2 common factors, obtained through a rotation Varimax with Kaiser Normalization converged in 3 interactions. We obtained two factors represent the innovativeness.

- The first factor is related to the development and introduction of management innovations of significant importance and contribution to improve corporate profits. We call for "Management Innovativeness".
- The second factor pertains to the market introduction of product innovations of significant importance, and its contribution to improving corporate profits, the introduction of significant process innovations and their importance for cost savings and other improvements. We call it "Product Process innovativeness"

The factor analysis indicates a reasonable correlation between the variables included (KMO = 0.536). The test of Bartlett's sphericity is associated with a significance level of 0.000, from which it follows that there is a correlation between some variables. Both tests allow the continuation of factor analysis.

After this, to see the effect between constructs we makes use of linear regression techniques that allow us to evaluate and compare which is the direct effect of each independent variable on the dependent question (Jardón, Verdugo, & Cal, 1997).

4.3 ANÁLISIS AND RESULTS

We did a regression with all variables of structural Capital, selecting the B's with values greater than 0.200 demonstrating the existence of robust relationships between the constructs.

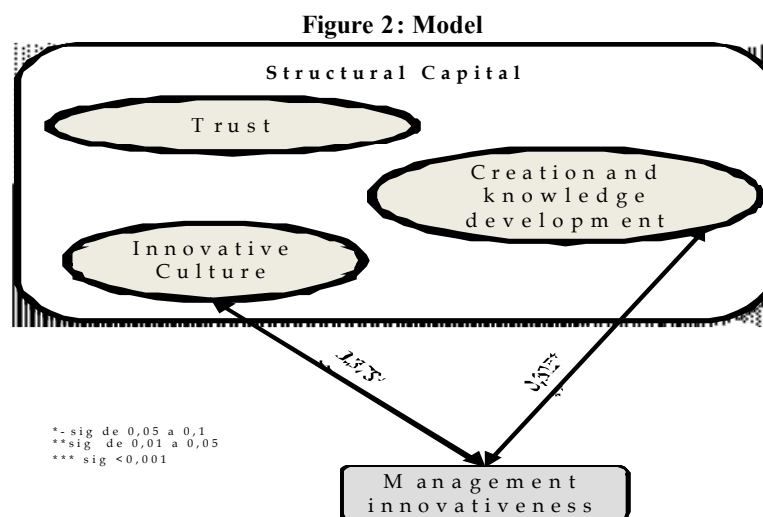
Table 5 Regression Matrix: management innovativeness.

Modelo		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
2	Innovative culture	,378	,107	,378	3,529	,001
	Creation and Knowledge Development	,315	,107	,315	2,940	,005

Considering the results obtained with the Multiple Linear Regression analysis, we note that structural capital is related with the Management innovativeness, so, different innovative capabilities require a differentiated intellectual capital elements.

Considering the results obtained with the Multiple Linear Regression analysis, we note that only the Capital Structure is related to the Innovative Capacity Management. We proceed with the analysis of the relationship between aspects of Capital Structure (Innovative Culture, Creation and Knowledge Development, and Trust) and the Management Innovativeness.

The results obtained with the Multiple Linear Regression analysis, indicate that the management innovativeness is positively and significantly influenced by the Innovative Culture (.378, with sig. 0.001) and the Knowledge Creation and Development (0.315 with sig. 0.005). It is the following model:



First, before moving on to discuss the results obtained with the statistical analysis, we analyze the scales used for measurement.

As an introductory note the structural capital start we 20 items. These items grouped gathered four groups of characteristics. Once we done the exploratory factor analysis of the items relative to structural capital, they have been grouped differently than initially considered, resulting in three new factors the "Innovative Culture", "creation and knowledge development" and one more item of "Trust."

The scales on the innovative capacity did not have to be modified because it coincided with the resulting scale of exploratory factor analysis. The first factors, the "Management innovativeness", consists of two items on the " innovation management ", which relates the introduction of innovations in management of significant importance and their contribution to improving corporate profits.

The second factor found is "Product-Process Innovativeness" which is composed of two items of "product innovation" and two items of "innovation process." These reflect that the introduction of product innovations are of significant importance and contribution to improve corporate profits and the introduction of significant process innovations and their importance in reducing costs and other improvements.

After analyzing the measurement scales used, then, we present the statistical analysis findings. With these findings we test the hypotheses. We validated partially our hypothesis H.1.

Table 1. Hypothesis test

Hypothesis	Situation	
	Management innovativeness	Product-process innovativeness
H1: Structural capital is positively related with the innovativeness of the company.	ACCEPTED	Rejected

We observed that the Structural Capital is directly related to the management innovativeness, these results are validate by theoretical arguments (Davenport, et al., 2003) that consider that is the company that turns knowledge into performance. Businesses should support the performance of employees through their infrastructure, information systems, routines, culture and trust, facilitating the dissemination of knowledge. Companies must develop a culture that encourages and promotes the retention of Human Capital (Cabrita & Bontis, 2008).

The relationship between structural capital and the innovativeness was also contrasted by Subramanian and Youndt (2005) (Organizational Capital in their case) and they verify the existence of a significant relationship with incremental innovation capacity (not all types of innovative capacity.)

In our study, we found no direct relationship between Trust and any innovative capacities considered. This result is inconsistent with the position of different authors, who consider trust as a basic condition for the efficiency of the processes of creation and knowledge transfer (Adler & Kwon, 2002; Ford, 2001), because it facilitates cooperation and creates operational efficiency of work teams (Galdford & Drapeau, 2003).

In our case the Creation and Knowledge Development appear directly correlated with the Management innovativeness. And, we found that the management innovativeness is significantly explained by the Innovative Culture, exposed the existence of a set of processes and procedures, with detailed descriptions of tasks, focusing on promoting learning and innovation and also a good collection system and implementation of innovations, as

innovation-oriented department. We can summarily conclude that our study supports that Structural Capital influences the innovativeness of the company although there are some nuances worth noting. An important result achieved is that we find a dichotomy between the Innovative Capacity. This dichotomy is very relevant for our finds and conclusions.

5. Conclusion

In this study we found several important contributions for theory. We identify theoretical implications of our study, mainly in two subject areas: the literature of Intellectual Capital and Innovation literature.

For the literature of intellectual capital, this work produces two major contributions. The first contribution is that we found that some dimensions of structural Capital are relevant for the innovativeness of the company.

A contribution from this research is to the innovation literature and concerns the several innovative capabilities found in this study. First we saw that the Management innovativeness and the product-process innovativeness are differentiated which consequently require different knowledge. Furthermore we saw that the product-process innovativeness are coincident and refer to the same phenomenon. We found that a new product innovation needs a new process, which justifies that the product process innovativeness represents a same capacity. So, there is a need to adjust the production process of a product innovation. It means that these two types of innovation are intrinsically related.

The developed model validated the research problem and led to the following general conclusions:

- The first conclusion is that the Intellectual Capital influences the innovativeness of the companies producing components for the automotive sector within the European region of Galicia and Northern Portugal;
- The second conclusion confirms that Management innovativeness is influenced positively and directly by structural capital.

As limitations of the study we found that measuring innovation with a survey is sometimes a limitation because respondents can only give 'rough estimates' of the percentages used to measure innovation output, so, the answers can be affected by subjectivity. However, this is especially a problem when the comparison is made among firms working in different sectors. In this study, we only compare the innovative performance of firms in the same industry and, therefore, our results are less likely to be affected by this.

Further study should be done in two senses: to provide further evidence of our conclusions testing our model in different sectors or doing a multisector test. More research should be done on the role that capital intellectual play in different stages of the new products development process, as little is known about this relationship.

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