

INTELLECTUAL CAPITAL AND INNOVATION: SOME NEW DEVELOPMENTS

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Abstract. *The main objective of this paper is to compare what they present [3] and [4], regarding the content, in the relationship between intellectual capital and innovation. Intellectual capital does not yet (year 2020) have a consensual definition. Therefore, studying these 2 topics together, is of some importance, but conditioned by this fact. However, it is useful to know what conclusions the authors reach and what contributions they make to the enlargement of scientific knowledge in the area. The approaches in terms of method used are quantitative. The main conclusion to be drawn from the 2 papers, synthetically, is that, whether we are in the presence of companies with high or low technological intensity, the effects on, product and/or service innovation, innovation management and on the capabilities development of massive products customization, depends on complex and interrelated relationships between each of the components of the notion of intellectual capital that was adopted. This constitutes new insights in the relationship between these 2 topics. It can be said that, if another conceptual definition of intellectual capital was used, its effects on innovation studied by these same authors, would lead to other completely different results, especially if one considered, namely, another variable which is the sales of each company. This, would allow to know the relation of the dimension either by the side of the work factor possessed as well as by the income created by them. Synthetically, the 2 authors, excluding the sales, excluded from their analysis the value of the business wealth created that is due to the same topics, individually or together. And, for that reason, they limited the scope of the analysis performed and the contribution to the enlargement of scientific knowledge.*

Keywords: *Intellectual Capital, Innovation, capabilities Development of Massive Products Customization*
JEL: *J24, J41, M54, O31, O32, O33*

1. INTRODUCTION

Intellectual capital alone, inside the scope of intangible assets, has deserved some attention from authors such as [1], [2] and [3], who, among others, address their definition. [1], define intellectual capital as the sum of human capital, structural capital and customer capital components. [10], by your side, define it as being the sum of human capital, structural capital, customer capital components but also more the relational capital and innovation capital components. Not only the number, but also its meaning has repercussions on what is intellectual capital.

If there is a lack of consensus on what it is, from the point of view of the definition, there are problems in measuring it and

knowing its value. Thus, further studies that need to know what intellectual capital consists of, with a formal definition and recognized as being appropriate to apply, are also impaired.

Previous works that relate intellectual capital to other topics, such as innovation, have a problem in their development: they are conditioned by this shortcoming. In the specific case, we have the problem of knowing, how to bypass these studies and their respective authors, if they do not have one basic definition accepted?

Two authors such as [3] and [4], take an approach that links intellectual capital with innovation. They are recent authors and give an idea about what is the most recent published in this field. The aim is to develop the paper with the same titles of these 2 authors and allow an explicit comparison to better understand them.

Thus, the research question is: how does this duo develop, intellectual capital and innovation, interconnecting it, knowing at the outset that a definition of intellectual capital that is accepted, common and that allows comparisons is missing?

This question comes from knowing how the authors carry out their development, conditioned, right from the start. This is an important issue as it starts from a non-existent definition, because it is not accepted by consensus, and that may condition development, particularly in the results of the papers, especially if related to another topic such as innovation.

The contribution to the expansion of knowledge, is linked to the fact of knowing how far the authors who decide to do these papers go and knowing what new knowledge they have brought, knowing in advance that a single absent definition, restricts and limits the entire process of intentions. It should be noted that the definition of intellectual capital adopted by the two authors is different.

[3] Address, in an empirical way, what are the repercussions of intellectual capital, on the innovation processes in the design of products and also on the capabilities development of massive products customization, in the manufacturing sector, of 645 companies from 10 countries/regions for the period 2007 to 2010.

Intellectual capital is seen as a stock of knowledge that each company has and is divided into 3 components: human capital (workers' qualifications), social capital (interactions and relationships between workers) and structural capital (information systems and procedures operative).

The empirical evidence researched by the authors states that intellectual capital is positively related with business performance and also innovation processes in product design. The repercussions of each intellectual capital component on

these innovation processes are different in each one. Thus, the authors intend to know these same repercussions, of each intellectual capital component, namely, the mechanisms through which they occur, together, and also the development of the capabilities development of massive products customization, in the manufacturing sector.

Two questions are subject to research (research questions) by [3]. First, how do the 3 intellectual capital components affect, jointly, the innovation processes in product design and the capabilities development of massive products customization in the manufacturing sector? Second, what are the roles played by innovation processes in product design and the capabilities development of massive products customization in the manufacturing sector? For their part, [4], they designed a paper whose content is related to knowledge as a business resource, being interpreted as the key factor of innovative activities. However, there is little knowledge between the impact of specific contingencies on the relationship between intellectual capital and innovation. Therefore, ultimately, the paper seeks to ascertain the technological level of business and innovation. The companies considered in it are of low and high technological intensity. The sample used, which covered the period from October 2013 to February 2015, is based on 180 Spanish companies with 100 or more workers. They were extracted from the SABI database. Regarding the technological point of view, the authors resorted to the definition of technological intensity, low and high, patent in [7]. According to them, some literature argues that, from the business point of view, managing innovation is nothing more than intellectual capital. This is defined as being made up of 3 components: human capital, structural capital and relational capital. It is a factor that creates innovation. There is yet another particularity highlighted by them [4, p. 2], which consists of recognizing that there are several types of innovation, mentioned in the allusive literature, and that there is still a lack of understanding about which intangible assets are more important, associated with, also, different types of innovation. Therefore, this is the basis that explains why managers have scarce guidance on what resources to invest in and whether they are the basis for creating different types of value within companies.

The management of product and service innovation is different for these authors, which is why it is also different, and it appears that each component of the intellectual capital referred to has a different degree of importance, dealing with products and/or services versus innovation management.

Like the previous authors, the goal is to find an answer to 2 research questions.

First, there is little knowledge about the role of intellectual capital in relation to different types of innovation. So, the purpose is to fill this gap, seeing what is the influence of the 3 intellectual capital components on innovation in products and/or services versus innovation management? Second, the lack of understanding about which intangible assets are most important for innovation, prevents managers from making informed decisions about it. So, in which intellectual capital components should managers invest, in order to better answer to the needs of companies? It is also associated with the question of how the relationship between intellectual

capital and innovation can be changed in companies whose difference is based on different uses, materialized in low and high technological intensity?

The paper is organized as follows. Section 1, Introduction, which presents some considerations about intellectual capital, namely, its definition, the problem and the research questions. In Section 2., we have what is presented as Literature Review and Research Hypotheses. In Section 3, the method used by each of the authors is shown. In Section 4, we have the Results achieved, In Section 5, the Discussion of the same, for in Section 6, we have the main Conclusions extracted by the authors. Finally, we have the references used in doing the paper.

2. LITERATURE REVIEW AND RESEARCH HYPOTHESES

[3], carry out a literature review in line with the topics of the paper: intellectual capital, innovation processes in products design, the capabilities development of massive products customization and research hypotheses.

With regard to intellectual capital, these authors proceed with a more detailed development on what to understand by human capital, social capital and structural capital. These are the 3 components referred to in which it unfolds, in the concept adopted by them. Its base creates competitive advantages being the origin of different types of knowledge. Therefore, the key idea of this topic is that intellectual capital is seen as a special knowledge composed of these 3 components, which can take on different forms and expressions, contributing, as a whole, to define the total intellectual capital of a company and, from it, assume specific values.

Regarding to innovation processes in product design, it consists of the ways in which companies produce products and/or services. It encompasses new elements and advanced technologies in the production processes, instilling improvements in the speed, quality, efficiency and confidence that the production of products deserves in the eyes of customers. It requires creativity from existing knowledge, ideas, methods and qualifications. If better, faster production processes are introduced, this will result in a company's superior capabilities over its competitors.

With regard to the capabilities development of massive products customization, it consists of providing, individually, the design of products, at a price that makes it possible to sell on the markets in massive quantities. It requires convergences between companies and the needs of customers, which is achieved by agility, flexibility and the processes used in an integrated manner. In developing the capabilities development of massive products customization, it consists of responding to customer requirements, individually and in aggregate, with high quantities of products, reducing delivery time, maintaining the quality possessed by them.

Finally, in the research hypotheses, there are 6:

1. Human capital is positively related to structural capital.
2. Social capital is positively related to structural capital.

3. Human capital is positively related to innovation processes in products design and with the capabilities development of massive products customization.
4. Social capital is positively related to innovation processes in product design and with the capabilities development of massive products customization.
5. Structural capital is positively related to innovation processes in product design and with the capabilities development of massive products customization.
6. Innovation processes in product design are positively related with the capabilities development of massive products customization.

[4], in the literature review, they address 5 topics and, at the same time, raise the 12 research hypotheses. Regarding the literature review itself, the 5 topics are as follows:

1. *Intellectual Capital* - refers that the recent evolution of research in this field is divided into 3 phases: the first, from the beginning of the 80s until the mid-90s and alludes to the fact of growing awareness about it alongside the recognition of its increasing relevance; the second, from the end of the 90's until the beginning of the 2000's, is characterized by the objective of measuring and managing it, without forgetting the analysis of the influence of this same intellectual capital on financial results; the third and last, has its center in understanding the bottom-up regarding the functioning of this same intellectual capital in reality. The classification of intellectual capital, to [4, p. 3], is divided into 2 large groups: one based on knowledge and the other based on a holistic perspective.

For the first, it is a business resource, while for the second, it is the sum of all resources that a company has, which includes the resource as knowledge and all other intangible resources. With regard to the conceptual definition, these authors refer to two possible types: that of [8] and that of [9]. For the first, intellectual capital, has 3 components, the sum of human capital, structural capital and client capital. For the second, it is also formed from 3 components, but it is the sum of human capital, social capital and organizational capital. They even mention [4] that, as stated [5], although they differ in expression, in substance they refer to the same. The second, being the traditional one, encompasses the dimensions of the interior and exterior of the organizational capital companies.

However, for [4], intellectual capital is equal to human capital, plus structural capital plus relational capital (internal and external). Conceptually, the human capital component, consists of the qualifications held by everyone who works in a company. The structural capital component is the accumulated knowledge that spreads throughout the company in structures and processes, such as information systems, namely. Finally, the relational capital component is subdivided into 2 - external relational capital (it is the knowledge and resources related to companies' relationships with the outside, v, g, customers) and internal relational capital (it is the included and available knowledge within the company through the WEB and the relationships between its members).

2. *Intellectual Capital and Innovation* - basically,

innovation is related to knowledge. Workers who have knowledge, especially specific, have a factor that facilitates innovation, immeasurably. The structural capital component, also facilitates this same innovation insofar as knowledge in information systems promotes innovation through its use. The authors emphasize that the creation of innovation within a company is not possible only with internal inputs. It also requires inputs external to it.

3. *The Role of Intellectual Capital in Innovation in Companies with Low and High Technological Intensity* - the context in which a company operates influences innovation to the extent that its technological intensity, constitutes a factor that stimulates innovation with the appearance and improvement of new products and/or services. If it is high, it involves more complex knowledge than if it is low. Therefore, if low, it creates less sophisticated relationships between intellectual capital and innovation than if it is high. In this one, the speed with which innovation arises is much faster than in that one. Coding information systems is easier in companies with low technological intensity and, consequently, incorporating innovation, than in high intensity ones where coding is more sophisticated, making the process more difficult. Companies with low technological intensity have a lack of innovation capacity, which allows them to be incorporated from abroad more easily. Those of high intensity have less lack of capability for innovation, which raises the problem that it is not possible for a single company to have all the capability for innovation, individually, because in these it is of a more complex design.

4. *Intellectual Capital in Products and/or Services versus Innovation Management* - according to [6], innovation can be incorporated into products, services, processes, marketing and advances in business practices. In the products, it consists of introducing improvements regarding the features that identify them or in the destinations that are given to them. Business practices consist of implementing organizational methods, in particular, in business, including workplaces and external relations. Expressions like *business practices* or others, today are considered to be an integral part of innovation management. The distinction between the various types of innovations is of utmost importance, as this avoids, or at least mitigates, any instability in the results of researches and researchers. In the various types, according to [4, p. 5], these underline the importance of the human capital component and the qualifications held by workers, therefore. With regard to the structural capital component, it generates innovations. According to these same authors, changes in the structure of companies arise, affecting their core business. This management of innovation implies new approaches for the management of workers to be better, obtaining better performances, new processes and introducing changes in the business strategy, structure, procedures and systems. With regard to innovations related to products and/or services, these are introduced to satisfy the needs of customers and innovation management takes on different shapes from other types: internally, it increases business efficiency and effectiveness and, externally, it requires checks that have consequences on the internal contours. The exchange of

knowledge between workers highlights the importance of innovation management, whereas only new knowledge from customers and suppliers only promotes products and/or services.

5. *Control variables* - these are the size and sector of activity to which the 180 Spanish companies selected in the sample belong. When inside the companies, hierarchical levels are scarce, namely, they have few capabilities and resources but, however, cooperation between companies blurs this shortcoming. Therefore, in this context, the dimension has a negative effect on innovation, while the sector of activity makes the propensity for innovation to change from one sector to another (assuming this change is possible), exerting a positive effect. Companies in the manufacturing and services sectors are distinguished.

Regarding the 12 research hypotheses are:

H1: Human capital component positively affects

- (a) product and/or service innovation in
 - (i) high technological intensity companies and in
 - (ii) low technological intensity companies
- (b) innovation management
 - (i) high technological intensity companies and in
 - (ii) low technological intensity companies

H2: Structural capital component positively affects

- (a) product and/or service innovation in
 - (i) high technological intensity companies and in
 - (ii) low technological intensity companies
- (b) innovation management
 - (i) high technological intensity companies and in
 - (ii) low technological intensity companies

H3: Internal relational capital component positively affects

- (a) product and/or service innovation in
 - (i) high technological intensity companies and in
 - (ii) low technological intensity companies
- (b) innovation management
 - (i) high technological intensity companies and in
 - (ii) low technological intensity companies

H4: External relational capital component positively affects

- (a) product and/or service innovation in
 - (i) high technological intensity companies and in
 - (ii) low technological intensity companies
- (b) innovation management in
 - (i) high technological intensity companies and in
 - (ii) low technological intensity companies

H5: The influence of human capital component on

(a) products and or services and
(b) performance in innovation management is significantly higher in high technological intensity companies than in low technological intensity companies

H6: The influence of structural capital component on

(a) products and/or services and
(b) performance in innovation management is significantly higher in high technological intensity companies than in low technological intensity companies

H7: The influence of internal relational capital component on

- (a) products and or services and

(b) performance in innovation management is significantly higher in high technological intensity companies than in low technological intensity companies

H8: The influence of external relational capital component on

- (a) Products and/or services and

(b) Performance in innovation management is significantly higher in high technological intensity companies than in low technological intensity companies.

H9: Human capital component is equally relevant to both products and/or services and performance of innovation management and in

- (a) high technological intensity companies and in
- (b) low technological intensity companies

H10: Structural capital component is more relevant to the performance of innovation management than to the performance of product and/or service innovation in

- (a) high technological intensity companies and in
- (b) low technological intensity companies

H11: Internal relational capital component is more relevant to the performance of innovation management than to the performance of product and/or service innovation in

- (a) high technological intensity companies and in
- (b) low technological intensity companies.

H12: External relational capital component is more relevant to the performance of innovation management than to the performance of product and/or service innovation in

- (a) high technological intensity companies and in
- (b) low technological intensity companies

3. METHOD

[3]. Obtained the information to build the sample from the *Global Manufacturing Research Group (GMRG) Round 4.0 Survey*. The approach used was quantitative.

It comprises 645 companies from 10 countries/regions. Items from this database were selected for each intellectual capital component and innovation processes in product design and the capabilities development of massive products customization. The method of factor analysis was used only, synthetically. The use of a model of structural equations was also carried out, in terms of the results of the answers to the hypotheses.

[4]. used the SABI database - *System of Analysis of Iberian Balances*, which contains more than 2 500 000 Spanish and Portuguese companies to, after a selection process, choose only 180 Spanish companies with the particularity of have 100 or more workers.

In general, they resorted to a quantitative approach. The method used was the structured questionnaire (response rate of 25.71%) to managers (generic designation) of 180 companies. The profile of the respondents was 89.44% (being 3.89% directors, 67.22% human resources managers and 18.33% responsible for other departments) and, the remainder, 10.56%, was workers that did not occupy any specific function. Among these 180, and according to the criterion defined by [7], they were classified according to their technological intensity. Thus, according to this criterion, of the 180 companies, 86 were of high technological intensity and 94 of low technological intensity.

Based on the report, elaborated from the structured questionnaire, the authors used a Likert scale (whose answers vary between 1 and 5). Then, dependent and independent variables were defined. The hypotheses tests were statistically performed using a model of structural equations, which was based on the method of partial ordinary least squares, as well as a multi-group analysis (with the goal of verifying whether the coefficients differ, statistically, significantly among companies with high and low technological intensity). Bootstrapping techniques were also used.

4. RESULTS

With regard to their results, [3] they concluded that human capital component improves innovation processes in product design, directly and indirectly, via structural capital component and this, in turn, partially intervenes in the impact of capital knowledge about innovation processes in product design.

Social capital component only has an indirect impact on innovation processes in product design. Consequently, the effects on innovation processes in product design are carried out entirely via structural capital component.

Innovation processes in product design, only partially intervene in the impacts of human capital component on the capabilities development of massive products customization and, on the other hand, fully intervene in the impact of structural capital component on the capabilities development of massive products customization.

[4], regarding the results, carry out the treatment subdividing into 4 topics: descriptive analysis, evaluation of the measurement model, evaluation of the structural model and post hoc analysis.

With regard to the descriptive analysis, it should be underlined that only the intellectual capital component, human capital, shows differences between companies of high and low technological intensity. This is due to the qualifications and expertise of the workers (higher in companies with higher than low technological intensity). The degree of development of each of the 3 components of intellectual capital, proved to be similar, as was the degree of products and/or services, as well as the performance of innovation management.

Regarding the evaluation of the measurement model, the indicators reliability as well as validity, were analyzed and revealed adequate values for the study in question.

With regard to the evaluation of the structural model, the human capital component of intellectual capital has shown to positively affect innovation in products and/or services, as well as innovation management in companies with high technological intensity. In low, no. The structural capital component and its influence on innovation has shown to have positive effects except on companies, which produce innovative products and/or services in the case of companies with high technological intensity. The direct influence of the internal relational capital component on innovation has not been revealed to exist. The same, regarding the external relational capital component, in which it only revealed itself as influencing innovation in products and/or services. It was

also observed that the influence of the human capital component on innovation in products and/or services, is greater in companies with high technological intensity, than in those with low technological intensity. The influence of the structural capital component, with regard to innovation in products and/or services and the management of innovation is less in companies with high technological intensity, than in those with low technological intensity. Differences between internal relational capital, in high and low technology companies, were not found. The same in external relational capital component.

On the other hand, the influence of the human capital component on the innovation of products and/or services and on the management of innovation, proved to be similar, both in high and low technological intensity companies. However, the influence of the structural capital component on innovation is far greater in the case of innovation management, than in the case of product and/or service innovation, in both types of companies in terms of technological intensity. Regarding the internal relational capital component, the effects on innovation proved to be irrelevant in high and low technological intensity companies, whereas in the case of external relational capital component, the results showed that they were greater in the innovation of products and/or services. and in the management of innovation, both in high and low-technological companies. It should also be noted that, in the control variables (remember, company size and activity sector), only the first revealed to have an influence on innovation in products and/or services, in high technological intensity companies. It was observed that, if the companies are small and with high technological intensity, the innovation in the products is bigger and better, which translates into a higher business performance.

From a statistical point of view, the H1ai and H1bi, proved to be not rejected. H1aii and H1bii were rejected. For their part, H2aii and H2bi as well as H2bii, were not rejected, but H2ai was rejected. The H3 hypothesis was also rejected. The H4ai and H4aii hypotheses were not rejected, but the H4bi and H4bii were rejected. H5a was not rejected, but H5b was rejected. H6 was not rejected. H7, on the contrary, was rejected. H8, for its part, was not rejected. The H9 hypothesis was not rejected. The H10 hypothesis, too. The H11 hypothesis was rejected instead of the H12 that was not rejected.

Finally, with regard to post hoc analyzes, it was found that several intellectual capital components, have not shown to have an influence on innovation, as is the case of H1 to H4. What interpretation of these results? Is the rationale that the components are irrelevant or is it due to the fact that the influence comes from other intellectual capital components? As the authors checked the irrelevant components in isolation, they concluded that the components, structural capital and internal relational capital, are definitely irrelevant in the context of product and or service innovation, in high technological intensity companies. The same happened, with the human capital and internal relational capital components, but in companies with low technological intensity.

In the case of innovation management, the internal and external relational capital components emerged as affecting

innovation via the influence of the human capital and structural capital components in high technological intensity companies, while in the low, the human capital component, and internal and external relational components, may affect innovation through the influence on structural capital component. Via bootstrapping techniques, the results showed that there is an indirect influence of the internal relational capital component on the human capital and structural capital components on innovation management. On the other hand, they also showed that the external relational capital component is influenced, via the human capital component, but not via the structural capital component. In low technological intensity companies, the results show that the human capital and internal relational capital components, indirectly, influenced the management of innovation, via structural capital component but not via external relational capital component.

5. DISCUSSION

[3] Found evidence that human capital component improves the development of capabilities development of massive products customization, directly and indirectly, through innovation processes in product design. This improvement in the development of the capabilities development of massive products customization is achieved through the development of new products that can be applied to improve the capabilities development of massive products customization. It is also carried out via the design of new processes, which derive from the requirements and requirements of customers. On the other hand, in the social capital component, the results show that the capabilities development of massive products customization can be improved also due to this. The improvement of innovation processes in the design of products, only take place, indirectly, via structural capital component. It allows workers to exchange impressions with each other, and in this way, make them improve the way they produce, more quickly and in a more sophisticated way. Structural capital component, directly, improves innovation processes in product design, but only improves the capabilities development of massive products customization, indirectly via innovation processes in product design. In the course of these processes, these authors understand that, structural capital component can be used to produce new knowledge within companies via internalization and combinations that increase their production capabilities. [4], refer that the existing literature detected differences between companies, according to the technological level and the type of innovation, in the context of analyzing the relationship between intellectual capital and innovation. This study, in particular, has shown that these differences must be taken into account. Thus, with regard to product and/or service innovation, external relational capital component increases innovation, whatever the technological intensity of the companies. Whether of high or low technological intensity, solid external relations, between suppliers and customers, must be built to create innovative products and/or services. The internal relations, proved to be irrelevant in this same context, whatever the technological intensity of the companies. This opposition, with regard to the development

of product and/or service innovations, is in the components of human and structural capital components. The former influences these innovations mainly in companies with high technological intensity while the latter influences low companies. This is explained by the skills of the workers that must be constantly improved, accompanied by the use of information systems. Low technological companies are more dependent on knowledge, which explains their greater dependence on the structural component.

The dimension has a negative impact on companies with high technological intensity because they reveal greater difficulty in making decisions and are less agile in implementing innovations.

In the management of innovation, the structural capital component, plays a role in both types of companies. With the development of new management practices and methods, it brings enormous benefits related to the codification of knowledge. It is a reality, especially in companies of low technological intensity that use knowledge that is easy to code and use and to be transferred in space.

In companies with high technological intensity, the human capital component plays an important role in increasing innovation management, because it comes from the increase in the relationships that are established between workers (internal relational capital component) and with external agents (external relational capital component). Internal relational capital component can even reinforce the structural capital component. Thus, in itself, relations between workers do not influence innovation by themselves: they contribute to increasing the skills and motivation of workers.

In companies with low technological intensity, the human capital component and the internal and external relational capital components, stimulate business innovation via the structural capital component. Even in the case of the human capital component, increasing innovation by improving it, the low complexity of knowledge management in companies with low technological intensity, explains the fact that workers' knowledge and motivation are simple factors that promote the structural capital component. In companies of high technological intensity, knowledge generates knowledge, influences innovation, directly, even if it has to be coded and stored in information systems. The relations between workers, stimulate the structural capital component. The influence of the internal and external relational capital components in improving innovation management shows a contrast with the features of the different types of innovation. This may be due to the fact that, more uncertain variables, may affect intellectual capital and its relations with innovation or innovation management, which need better research to also better understand the topic.

6. CONCLUSIONS

[3], underline some of the most notable evidence from their study. Among them, it is worth mentioning that it provides empirical evidence regarding intellectual capital that contributes to improving the capabilities development of massive products customization, either directly or indirectly. This is mediated by innovation processes in product design,

which induce a more accurate understanding of how to develop this same capability. On the other hand, the results also underline the fact that the workers' knowledge makes a helpful contribution in this same path. In particular, providing insights into how knowledge within companies has an effect on the capabilities development of massive products customization (p. 10). Innovation processes in product design not only improve but also mediate the effects of human and structural capital components on the capabilities development of massive products customization.

From another point of view, it is also concluded that the study provides insights regarding the repercussions on the effects of human capital and social capital components and also structural capital component on innovation processes in product design and on the capabilities development of massive products customization. In particular, human capital component has a direct and positive effect on these two, whereas social capital component only contributes to the improvement of the capabilities development of massive products customization. Structural capital component only directly improves innovation processes in product design. Thus, the authors note, different effects of the various intellectual capital components on the capabilities development of massive products customization, insofar as they improve the existing knowledge, of the impacts of intellectual capital on business performance. Human capital and social capital components increase structural capital component and this mediates the effects of innovation processes on product design, human capital and social capital components. In summary, these results provide an improvement in the interrelationships between human capital, social capital components and structural capital component and the effects they induce on innovation processes in product design.

This study provides some useful contributions for managers. They can infer that they must invest in the three intellectual capital components, in order to exchange knowledge between workers. A corporate culture should be introduced in companies, in such a way as to facilitate this interconnection between workers. Managers should be aware of the different impacts on innovation processes in product design and on the capabilities development of massive products customization. Of the three intellectual capital components, attention should be given a special focus, in the human capital component and in the social capital component, in the capabilities development of massive products customization.

The relationships between the three components should be taken into account by the managers when they make decisions related to the companies that are under their responsibility.

As limitations posed by the study and which constitute avenues for future research, there are those that the internal knowledge of the companies is not sufficient. Knowledge external to companies should also be given special attention. In particular, in what way and to what extent, external and social capital components has effects on internal human capital component and on structural capital component and also on the results that are related to business performance. What are the impacts of different types of investments on

human capital component, such as training and professional training? As the samples are sometimes uneven in different countries, this constitutes a shortcoming to the development of studies along the same path, in which the samples are homogeneous so that the response rate is equal.

Answer to the first research question: the effects of the 3 components are different. Human and social capital components increase the structural capital component and this affects the effects of innovation processes on product design. With regard to the capabilities development of massive products customization, in the manufacturing sector, the human capital component has a direct effect, the social capital component also, especially for performance. Thus, the effects of each component are also distinct. Answer to the second research question: instill improvement in the intellectual capital components, such as the human capital component with effects on both and the social capital component with only effects on the second.

[4], present some aspects that, by way of conclusion, resemble the most conclusive. Thus, from the outset, they state that the relationship between intellectual capital and innovation has differences that are based on two pillars: on the type of connection studied and on the technological level of innovative companies. With regard to the type of innovation, the results that were obtained are in line with those found by other authors consulted by [4]. They show that in the face of different types of innovation, the relationships established with companies, as well as being different, their effects are not the same. Product and or service innovation as well as innovation management, requires different combinations in the 3 intellectual capital components. This reinforces the importance of considering not one but several types of innovation, not only because there is not one type but, especially, because its variety is plurifaceted as well as its effects.

With regard to the type of company, in its technological intensity, the study of these authors confirms some ideas already known, namely, from [5], according to which, the context is relevant because it influences the way in which knowledge is used with regard to value creation. In this study, it is demonstrated that, the differences emanating from the technological level, in knowledge, is a factor that influences the way in which intellectual capital affects innovation.

Overall, there are two strongest contributions to this paper. The first is that it highlights the fact that knowledge-based differences fit into various types of innovation. It demonstrates that the relationship between intellectual capital and innovation is unraveled with regard to innovation in products and/or services and the management of innovation. According to the authors themselves, one of the potentialities of this paper is to enable other researchers to confront the antecedents between intellectual capital in relation to product and/or service innovation, as well as innovation management, and, on the other hand, those that are the result of discoveries and new developments among them, in more recent times. Virtuality has to do with the fact that this paper advances contingent factors that are based on the fact that intellectual capital has effects on the performance of the various

contexts. There is an expansion of the domain of knowledge in the area, which has the effect of increasing the understanding of the factors that influence the way in which intellectual capital supports innovation, especially with regard to the way in which intellectual capital establishes links with innovation. in products and/or services as well as innovation management, both in high and low technological intensity companies.

As implications of the paper, it is emphasized that managers must be aware that innovation in products and/or services, as well as innovation management, require different antecedents of intellectual capital. On the other hand, they should also be aware that innovation is not promoted in the same way in the case of companies with high or low technological intensity. The authors recommend that managers should be concerned with improving the human capital component, in order to discover new skills of workers with effects on innovation. Based on this fact, the type of innovation that the company intends to develop and its technological level, managers should see what their workers need, that is, the actions and decisions to be taken in order to align with the human capital component and the gap that may exist. Since the human capital component is embedded in other intellectual capital components, managers must know what kind of innovations they want to create and what is the technological level of the companies in which they are inserted. This makes it known which components are to be developed, and which increase the structural capital component.

As the human capital component has knowledge, this should be used taking into account, the context of the increase in information systems. Regarding the internal relational capital component, managers must prevent workers from thinking that developing innovations is easy. On the contrary, the same managers must make it believe that this same component may not be sine qua non for the development of new types of innovation, which requires that scarce resources be well managed. Finally, the promotion of the external relational capital component depends on the type of attractiveness sector in which the company operates. The exchange of relationships between customers can provide relevant knowledge for the company to innovate.

In the limitations of the paper, which may serve as a basis for future research, the authors point out 3?

- As the sample companies are only Spanish, this may affect and skew the results due to features derived from this fact;
- The information obtained came from only one person per company;
- This paper only focuses on 4 intellectual capital components. Future research should extend to other components, such as renewed capital, entrepreneurial capital and the influence of innovation in strengthening intellectual capital.

A case study in which the causal relationship between innovation and intellectual capital was researched in depth, could provide insights regarding the ways in which innovation influences business knowledge. These limitations, explored, constitute future avenues for research that will make it possible to expand knowledge in this field.

Answer to the first research question: it requires different combinations between the three intellectual capital components, depending on the business context and its technological intensity.

Answer to the second research question: in human capital component and in the components that the innovation of products and/or services requires more. The relationship between the intellectual capital and innovation, can be changed, with an increase in knowledge of the factors such as intellectual capital supports and establishes links with innovation in products and/or services, beyond to their management.

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