Human Capital as a Mediating Factor of Structural Capital and Value Addition

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ABSTRACT

Structural capital is one of the components of intellectual capital. The measurement is essential in order to obtain the real value of intellectual capital and its influence on the profitability of the business. The measurement of structural capital value addition can be done directly or via the mediating effect of another component of intellectual capital (i.e., human capital or relational capital). Human capital has been selected as the mediating component for this study based on findings of previous studies that advocate its importance as a major determinant that enhances structural capital changes. This paper aims at measuring the influence of human capital as a mediating factor on the capacity of structural capital value addition for the period of 2002-2018, for Galicia (Spain) and Portugal.

KEYWORDS

Human Capital, Intellectual Capital, Mediating Factor, Mediator, Relational Capital, Structural Capital, Value Addition, Wood Sector

1. INTRODUCTION

Forestry is (still) an important economic sector that makes substantial contributions in the rural socioeconomic context and influences environmental conditions. Indeed, forestry can complement traditional agricultural production, generating more income in less dense zones and creating employment (Mourão & Martinho, 2016). Forestry is being increasingly recognized as a critical activity for retaining viable livelihoods within rural areas of many EU countries (Slee, 2006). The agroforestry sector occupies a large part of the EU territory, giving a very important role to agriculture and forestry in the conservation of EU environmental resources (Martins et al., 2014).

Intellectual capital is a concept that exists ever since human beings started working in an organized way, but only in the last few decades, has been discovered and recognized as an essential factor that creates value and increases the efficiency of the sector (Khan et al., 2020). Intellectual capital can be defined as the organizational resources which comprise its human capital, structural capital, and relational capital (Bontis, 1998).

The intellectual capital approach (Reed et al., 2006) applied to the value chain model (Porter, 1985) has not been much studied. The previous works are oriented towards the knowledge value chain (Bhatiasvei & Dutot, 2014; Bornemann & Wiedenhofer, 2014). There are hardly any papers about the industry value chain, and these are oriented towards intellectual protection or knowledge management (Erickson & Rothberg, 2012). There is no study in the forestry sector with this double

DOI: 10.4018/IJKM.291103

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approach. This paper combines the intellectual capital approach applied to the value chain model in the forestry industry.

The timber and related industries employ a large number of people, in the extraction, conversion, and finished products sectors and are an important industry in the Iberian Peninsula, that is mostly dominated by SMEs with a few large companies in the organized sector. An investment in intellectual capital can bring improvement in the welfare of the employees and increase the efficiency of the organizations, whether the sector is composed of SMEs or large companies. It is preferable to have trained human resource managers and operations heads as well as scientists who can bring long-term sustainable strategies for small businesses in their area of expertise. Consequently, the companies should strengthen their corporate culture and technological expertise to have more sustainable (Porter, 1985) activities and promote activities that enhance the competitive spirit of their staff (Jardón & Silva, 2017). In addition, the role of manufacturing workers is continuously changing due to the increasing automation of manufacturing processes. This requires workers to build up broader and deeper skills, that can be achieved via a participative knowledge management approach to empower manufacturing workers (conversion and finished product sectors) (Campatelli et al. 2016).

Value creation in the forestry industry is the sum of value-added created in each sector. Value addition created by intellectual capital may not be by all three components: human capital, structural capital, and relational capital. Every sector has its characteristics and as such, some of the components of intellectual capital may or may not create value. A generally accepted consensus is that human capital is considered the most important element of competitive advantage in most organizations and includes all the competencies of the people within the organization (Memon et al. 2009). Relational capital is closely related to the competitiveness of SMEs in the long term, providing them with favorable conditions for sustainable development and the convergence of a knowledge-based economy and society (Gogan et al., 2014). As structural capital, to a large extent, is invisible in traditional accounting, the important question of value extraction does not gain the same immediate attention (Edvinsson, 1997), but structural capital should be developed inside the organization to increase the organizational performance (Sherif & Sherif, 2006).

A few previous studies are found on the moderating or mediating effect of the components of intellectual capital. The study of Jardón (2018) on the timber industry of an area of Latin America found out that there is a mediating effect among the components of intellectual capital. Human capital generates relational capital; relational capital needs structural capital to improve the innovativeness of subsistence small businesses.

Similarly, in a study of Portuguese technology-based SMEs, Ferreira & Franco (2017) found out that intellectual capital has a mediating effect on the relationship between strategic alliances and organizational performance. The organizational performance of SMEs can also be brought through knowledge performance, which increases process performance and eventually customer satisfaction, reputation, and cost reduction (Supyuenyong & Swierczek, 2011).

Another study focused on the relationship between strategic innovation and the performance of SMEs in Yemen, by AIQershi et al., (2019), found out that human capital plays a significant mediating effect. Almost similar results were obtained by Chabbouh & Boujelbene (2020) on Tunisian SMEs, where human capital showed a positive influence on the degree of innovation and global performance through a perfect mediating role exercised by the degree of openness.

A study on people’s rural banks in Bali, Indonesia, by Ayu et al. (2019), found out that while human capital did not have a significant effect on the financial performance of those banks when mediated by structural capital, its influence on the financial performance of the banks increased.

The forestry industry presents specific characteristics (Li et al., 2012) in which, although structural capital is important, so is knowledge, especially local knowledge, since many companies use this knowledge to distinguish themselves from their competitors (Li & Toppinen, 2011). In addition, when companies are small, this aspect is even more important. significantly losing the organizational capacity of the company and other technological aspects more associated with large corporations.
One way to overcome this limitation is through inter-organizational knowledge transfer (IOKT) that enables organizations, including SMEs to improve operational and strategic performance (Al-Jabri & Al-Busaidi, 2020).

The culture is an important issue of structural capital (Benevene & Cortini, 2010) and possibly conditions the effect in forest industries, as these companies are very associated with the territory (Li & Toppinen, 2011).

The objective of this paper is to analyze whether structural capital per se creates value addition to timber and related industries sector of the Iberian Peninsula or whether human capital plays a mediator effect on structural capital in value addition. In addition, the paper analyses if the sector in the value chain or the territory condition this effect. In this way, two approaches are combined: the value chain and the intellectual capital, not previously introduced in this type of analysis.

We begin this paper with a theoretical framework presenting the hypotheses and the model used; followed by the methodology and discussion; and finally, we offer our conclusions and limitations of the study.

2. THEORETICAL STRUCTURE

Intellectual capital is defined as the set of intangible assets that generate value for the company. It is not observable, because it is intangible and cannot be captured by the senses (Jardón & Cobas, 2021).

Initially, intellectual capital and knowledge management were used interchangeably, but while they are interrelated, they are not the same. Knowledge management deals with the accumulation of knowledge in the organization and intellectual capital deals with the conversion of that knowledge into meaningful assets for the organization.

Knowledge management can be of two main types: explicit (the one that can be recorded and registered and easily transmitted to others) and tacit (the one that people have deeply imbibed in their brains and that cannot be recorded and transmitted, but simply observed and experienced) (Sanchez et al., 2012).

Intellectual capital has had several definitions and myriad methods of calculation ever since it was proposed and accepted. While it has been divided into several components, most authors come to a consensus that it includes three main components: human capital (the knowledge that is with the employees of the organization and that can be rented by the company but never owned), structural capital (the intangible assets, owned by the organization and that support the human capital) and relational capital (the goodwill of the organization with the external stakeholders, like suppliers, clients, government, etc.). Any study can aim at measuring the effect of intellectual capital or its components on a specific sector or region (Sveiby, 1997; Stewart, 1997; Bontis, 1998).

Intellectual capital by itself is of little value without the leveraging effect of the firm’s structural capital (Stewart, 1997). As per Bontis (2002), human capital is not a significant path to a firm’s performance, but structural capital is. When structural capital was analyzed as a mediator, it facilitated human capital about a firm’s performance. It showed a valid path from human capital to structural capital, and from there, to the firm’s performance.

The mediating role of human capital has been less studied in the literature, although there are some previous works, for example, human capital plays an important role as a mediator between strategic innovation and performance (Barron & Kenny, 1986). A study conducted in Indonesia by Handayani (2020) examined the role of human capital and adaptive creativity in firm innovation and concluded that adaptive creativity played a mediating role in the influence of human capital and firm innovation. Hsiao et al., (2016) concluded that social and human capital are key-mediating mechanisms through which locus of control influences entrepreneurship.

Human capital may play an important mediating role in improving the capacity to facilitate the relations between relational capital and organizational (structural) capital, as was seen in the case of
the Chinese hotel industry where it played a positive role (Liu et al., 2017). As per Justman & Teubal (1991), human capital is a major determinant of economic growth since it enhances structural changes.

In other words, firms that have employees with a high level of human capital adopt complementary technologies to achieve maximum efficiency out of structural capital and innovation (Caselli & Coleman, 2006). The innovation process requires a certain level of human capital to act on the structural changes (Vandenbussche et al. 2006).

In the case of timber and related industries, the ability of structural capital to create value is not questioned, but in some sectors, human capital has to play a mediating factor to enhance the value addition capability of structural capital. Timber and related industries are labor-intensive activities, where the human physical skills are more applied than the intellectual skills, and as such, the proper use of the structure requires better human capital (Jardón & Silva, 2017).

While most of these studies concentrated on studying the mediator effect of human capital on innovation and performance, none of them studied the mediator effect it plays on structural capital on a niche industrial sector such as timber and related industries.

The timber and related industries tend to depend on the philosophy of their founder for their strategies and their human capital lacks higher education and the differentiation is based on the experience of the personnel, and to a large extent on the culture of the region. Similarly, the structural capital is highly dependent on the corporate culture and technological know-how of the members of the organization, who have skills based on the local know-how, that enables them to differentiate themselves from the others in the same sector. The SMEs, due to their small size, tend to have a major lacuna in their relational capital, as they avoid consortiums and try to limit the use of external services. Their small size can be, at times, an advantage as it makes them flexible to the needs of their clients, but their markets are usually limited to the local area and never expand nationally or internationally (Jardón & Martos, 2013).

The value chain of the wood sector was combined into three main sectors:

- Extraction sector
- Conversion sector
- Finished products sector

The extraction sector includes the following SABI1 industries for Portugal: Forestry and its products, cork extraction, and silviculture; for Spain, SABI data covers Forestry and its products and related services, silviculture, and cork extraction.

The conversion sector includes the following SABI industries for Portugal: Carpentry, wood pulp, wood treatment, and wood sawmills; for Spain, SABI data covers: Construction carpentry, wood pulp, and wood sawmills.

The finished products sector includes the following SABI industries for Portugal: Wooden furniture, wood panels, paper and paper products, paper packaging, wooden packages, and parquet flooring; for Spain, SABI data covers: Wooden furniture, paper, and paper products and cardboard products, wooden baskets, wood packaging, wood panels.

Such a division into three sectors was necessary as the characteristics of the companies differed in the extraction, conversion, and finished products sectors.

**METHODOLOGY**

A variable is said to be a mediator when it explains the relationship between other variables. More precisely, the pure mediation relationship shows that the independent variable affects the mediator that causes changes in the dependent variable and there is no significant relationship between the independent variable and the dependent variable. Further, a variable is said to be a moderator when
it causes the modification of the relationship between the independent variable and the dependent variable (Birasnav & Rangnekar, 2012). In general, a given variable may be said to function as a mediator to the extent that it accounts for the relation between the predictor and the criterion. Mediators explain how external physical events take on internal psychological significance. Whereas moderator variables specify when certain effects will hold, mediator variables speak to how or why such effects occur (Baron & Kenny, 1986).

Using the data from the SABI database for all the companies in the industries related to the wood and ancillary sector for the financial years 2002-2018, but only considering companies that had financial data for 2016-2018, the human capital and structural capital and its effect on value addition were calculated for every company that had positive values (where VA > 0, HC > 0 and SC >0, respectively), year wise. All outliers (5%) were eliminated to get lesser skewed results. The data was divided country-wise into three main sectors: extraction, conversion, and finished products, to facilitate and segregate the interpretation.

The model proposed for this study is as under:

\[
\frac{VA}{TA} = \beta_0 + \beta_1 \frac{HC}{TA} + \beta_2 \frac{SC}{TA} + \mu
\]

Further, regressing SC on HC (the mediating factor), we have the following modification of the formula:

\[
\frac{HC}{TA} = \beta_0 + \beta_1 \frac{SC}{TA} + \mu
\]

The advantages of these suggested models are:

- The model can be used for both listed as well as unlisted companies and SMEs.
- It can calculate the value addition considering each of the components of intellectual capital separately, and thus surpassing the limitation of using a single numerator to calculate the efficiency of each component.
- Value added is considered as the sum of the intellectual capital of last year and the efficiency of each component in the current year.
- It does not require the market values, averages, or listed prices to calculate the intellectual capital efficiency.
- It enables comparison between companies and industries.

For this work, we used a one-way dynamic panel data regression model with the software R² to estimate the effect of human capital and structural capital in each equation.

In this study we aim to answer the following hypotheses:

**H1A:** Human capital plays a significant role as a mediating factor between structural capital and value addition in the extraction sector of Galicia.

and

**H1B:** Human capital plays a significant role as a mediating factor between structural capital and value addition in the extraction sector of Portugal.

The extraction sector of Galicia comprises activities of forestry and logging, cork extraction, silviculture, and other related industries. The property rights of Galician communal forests are private but collective with the passing of the Galician Act of Communal Forests of 1989 (Caballero, 2015). The extraction sector of Portugal is characterized by a small property dimension in the case of forests, which mostly have elderly and/or absent owners (Martins et al. 2014). Just like in Galicia, it is mainly composed of SMEs, in the unorganized sector, and some small subsistence businesses. While these small companies are not very professionalized, they should try to improve their human capital as it
will have a definite effect on improving the structural capital and become more competitive (Jardón & Silva, 2017).

Human capital is the basic component of intellectual capital (Wang & Chang, 2015), as knowledge resides in people and thus, skilled and trained workers make more efficient the processes and tasks (Jardón & Martos, 2012), even in SMEs. Structural capital, on the other side, is the supporting infrastructure of human capital (Bontis, 1999). In the case of the extraction sector, which is a labor-intensive industry, it is expected that human capital should add value directly as well as a mediating factor on structural capital value addition. We aim to measure the impact of human capital as a mediator on structural capital’s value addition capacity.

\( H2A: \) Human capital plays a significant role as a mediating factor between structural capital and value addition in the conversion sector of Galicia.

and

\( H2B: \) Human capital plays a significant role as a mediating factor between structural capital and value addition in the conversion sector of Portugal.

The conversion sector of Galicia comprises construction carpentry, pulp, and timber mills, which is mainly dominated by large companies, some of them not listed on stock exchanges. In Portugal, the conversion sector is made up of carpentry activities, pulp, and timber mills, mostly in the SME sector, with the prominence of some large companies, in pulp manufacture.

Even though human capital is more important as a source of competitive advantage in the case of SMEs, it is important to study it, regardless of industry type or size. Intellectual capital, per se, is of little value without the leveraging effect of the firm’s structural capital (Stewart, 1997). Structural capital is the embodiment, empowerment, and supportive infrastructure of human capital that provides the environment that encourages individuals to invest their human capital to create and leverage its knowledge (Cohen & Kaimenakis, 2007). While it is widely accepted that intellectual capital, through its three components, human capital, structural capital, and relational capital adds value to the sector, it is to be seen whether human capital also adds to structural capital’s ability to generate value as a mediator, in the case of the conversion sector.

\( H3A: \) Human capital plays a significant role as a mediating factor between structural capital and value addition in the finished products sector of Galicia.

and

\( H3B: \) Human capital plays a significant role as a mediating factor between structural capital and value addition in the finished products sector of Portugal.

The finished products sector includes every industry that is dependent on wood and is not a part of the extraction sector or conversion sector, namely paper, and its articles, cardboard, wood and its articles, wooden furniture, etc. In Galicia, the sector is characterized by the existence of multinational companies as well as SMEs, mostly in the unorganized sector. The finished products sector in Portugal also has multinationals and SMEs, but the tendency is towards smaller companies when compared to Galicia (Spain).

Consequently, the SMEs that carry these activities know how to adapt their products to the needs of the clients, as they know the local market, based on the traditions and culture of the territory (Gatto, 1999). Even though the importance of human capital may be lower in the finished products sector
as compared to the other two sectors of timber and related industries, the mediating effect of human capital on structural capital is to be seen.

RESULTS AND DISCUSSION

- Both human capital and structural capital create value directly in the extraction sector of Galicia, with significance codes of 0 and 0.001 respectively. In the extraction sector of Galicia, the direct mediating effect of human capital is significant, implying there is a partial mediation of human capital on structural capital. The hypothesis H1A is partially satisfied in this sector.
- Human capital creates value in the conversion sector of Galicia, with a significance code of 0, while structural capital does not create value directly. In the conversion sector of Galicia, there is no significance, implying that human capital does not play a role as a mediator on structural capital. The hypothesis H2A is not satisfied in the case of this sector.
- Both human capital as well as structural capital, do not create value directly in the finished products sector of Galicia. In the finished goods sector of Galicia, there is no significance, implying that human capital does not play a role as a mediator on structural capital. The hypothesis H3A is not satisfied in the case of the finished products of Galicia.
- While human capital does not create value directly, structural capital creates value directly with a significance code of 0 in the extraction sector of Portugal. In the extraction sector of Portugal, there is no significance, implying that human capital does not play a role as a mediator on structural capital. Hypothesis H1B is not satisfied for this sector.
- Human capital creates value directly in the conversion sector of Portugal with a significance code of 0.001, while structural capital does not create value. In the conversion sector of Portugal, there is no significance, implying that human capital does not play a role as a mediator on structural capital. The hypothesis H2B is not satisfied for this sector.
- Both human capital and structural capital create value directly, with significance codes of 0, in the finished products sector of Portugal. In the finished goods sector of Portugal, the direct effect is significant, implying there is a partial mediation of human capital on structural capital. Hypothesis H3B is partially satisfied in the case of finished goods of Portugal.
Knowledge management and intellectual capital are also influenced by the local culture and habits. In the case of timber and related industries, being a labor-intensive sector, local culture plays an important role. This effect is manifested in the different behavior according to the territory and the value chain, suggesting the specific culture associated with the sector and the region condition the effect of intellectual capital. From a managerial perspective, practitioners need to pay more attention to how knowledge processes can affect human capital individually and in groups (Intezari et al., 2017).

In the Oberá (Argentina) study of the timber industry, Jardón & Martos (2009) concluded that the only dimension of intellectual capital that directly affected performance was structural capital. While their study concentrated mainly on the SMEs of the region, human capital and relational capital played an indirect role in value creation.

However, in a more recent study in a region of Argentina (2012), the same authors concluded that human capital influences structural capital, which in turn generates relational capital. This approximates more to our conclusion for the extraction sector of Galicia, where both human capital and structural capital create value and human capital is a partial mediator for structural capital (our study does not include relational capital). Our study used a more extensive database, both in size as well as time, and covered every type of company, from large multinationals to SMEs and subsistence small businesses.

The study of Justman & Teubal (1991), based on a more structuralist approach to economic growth, that advocated that structural changes (structural capital, in our analysis) causes growth, as compared to the outcome of a process of capital accumulation. In our case, it can be seen that structural capital only creates value in the extraction sector of both regions and the finished products sector of Portugal. Our study does not match the authors’ statements, given that sectoral and regional differences, play a limiting role in the enhancement of value.

Caselli & Coleman (2006), in their study, concluded that skilled labor (human capital, in our case) are more efficient in the use of technologies (structural capital, in our case), as compared to lower-income countries unskilled labor, which are less efficient and so, less productive. In our case, we can also conclude that if the skills of human capital improve, so will the direct and mediating effect of human capital on value creation. A similar study by Vandenbussche et al. (2006) had similar conclusions, that skilled labor has a higher growth-enhancing effect on innovation. In the case of timber and related industries of Galicia and Portugal, the mediating effect of human capital on structural capital value addition is seen only in two sectors. This means that these organizations have not explored fully the potential of their human capital and no efforts are being taken for improving it.

**CONCLUSIONS**

The importance of intellectual capital in value creation and addition, mainly through the intervention of human capital has been widely studied in the literature. The importance of structural capital in value creation is well acknowledged, even though not much research on it has been undertaken when compared to the studies on human capital.

The timber and related industries’ value chain was divided into three sectors: extraction, conversion, and finished products, to better study the characteristics of value addition. Using cross-sectional data, we studied the contribution of human capital and structural capital in the value creation process to timber and related industries. The study demonstrated that human capital creates value in the extraction and conversion sectors of Galicia and the conversion and finished products sectors of Portugal, respectively, while structural capital creates value in the extraction sectors of Galicia and Portugal and the finished products sector of Portugal, respectively. The finished products sector of Galicia is the only sector that remained unaffected by both these components of intellectual capital. This is in line with the study of Jardón & Silva (2020).

Given that the timber and related industries are a labor-intensive sector, we then studied the effect that human capital could have as a mediator in the role of value creation by structural capital,
to test the findings of several authors that advocated that human capital plays an important role in the value creation of structural capital. Our findings showed that human capital plays only a partial mediating role in the addition of value by structural capital in the extraction sector of Galicia and finished products sector of Portugal, while in the remaining sectors, the mediating effect does not exist. This could be because the organizations have not fully explored the potential of their human capital or they are not investing in skilled labor.

MANAGERIAL IMPLICATIONS

Both analysis, value addition, and mediating effect show that some sectors use structural capital efficiently to create value, while others do not. Companies should analyze the factors that limit the use of structural capital (Lev et al., 2016). This should be an eye-opener to managers and CEOs of companies in the timber and related industries sector to improve the management of their companies and make better use of structural capital, either directly or through the mediation of human capital, to augment the creation of value.

The vast differences seen in the generation of value between the three sectors and the two regions under study suggest that actions must be undertaken to improve performance. This can be divided into sectorial differences and regional differences. While the former implies internal issues in the structure of companies, the latter suggests different political strategies. Another option is to create cooperation strategies between companies in different sectors to improve collective efficiency (Schmitz, 1995). The sooner these issues are addressed, the better will be the expected performance of the companies in the sector.

LIMITATIONS AND FURTHER RESEARCH

This study was done for a specific sector, namely timber and related industries of Galicia, a province of Spain and Portugal, which is comparatively a very small area of Europe. Thus, the results may differ if the same method is applied somewhere else and our conclusions should be applied with some caution.

We used quite extensive set of data ranging from 2002 to 2018, but the results of the study could differ if more recent years like 2019 and 2020 are added to the analysis. We measured the effect of human capital and structural capital in the addition of value but did not consider the contribution of relational capital to the value addition to intellectual capital. Had relational capital been added to the study, the results could have been different.

Nevertheless, this paper has definite implications for future research, both in the form of follow-up studies for the same region and same sector or other regions or other sectors. Our research highlights the importance of structural capital in the value creation process for the economy, even if there is no mediating effect of human capital.
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ENDNOTES

1 SABI: Database of listed and unlisted Iberian peninsula companies.
2 R: A Language and Environment for Statistical Computing, *R Core Team*, R Foundation for Statistical Computing, 2019, Vienna, Austria, https://www.R-project.org

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