An inductive typology of the interrelations between different components of intellectual capital

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Abstract

Purpose – The purpose of this study is to enhance knowledge of the full set of interrelations between intellectual capital (IC) components by providing an inductive typology of their strategic interactions. **Design/methodology/approach** - To answer the research question we conducted a content analysis of CEOs' letters to shareholders published by 122 companies among the 200 first companies from the *Fortune Global 500* from 2008 to 2012.

Findings - The results show that these three IC components interact with each other around the central position held by relational and structural capital. Our findings underline the evolution of these interrelations over the period studied suggesting a strategic use of an IC components' framework according to the economic context faced by a company.

Research limitations/implications – The study is based on the CEOs' letters that might limit the generalization of the findings. Nonetheless, this research highlights a full and fruitful set of interrelations between IC components providing a business practices-oriented typology.

Practical implications - This study provides deep insights into the interrelations between IC components that can significantly help managers to identify the strategic connections between IC dimensions.

Originality/value - This study contributes to the literature by expanding the actual academic classification of IC to five clusters of components. This research highlights that relational capital interacting with structural capital holds a central position in companies' business strategy.

Keywords Intellectual capital, interrelations, typology, content-analysis

Paper type Research paper

An inductive typology of the interrelations between the different intellectual capital components

1. Introduction

In our post-industrial economy, capital has expanded from the realm of tangibles to intangibles (Dean and Kretschmer, 2007). In this context, intellectual capital (IC) is becoming a crucial factor of a firm's long-term profit and performance in a knowledge-based economy (Yuqian and Dayuan, 2015, Bollen *et al.*, 2005, Wang *et al.*, 2014). IC is defined as set of intangible resources and capabilities possessed or controlled by a firm. These include knowledge, culture, strategy, process, intellectual property and relational networks that create value or competitive advantages and help a company achieve its goals (Reed *et al.*, 2006, Teece, 2000, Hsu *et al.*, 2009). The intangibility of this capital makes it difficult to imitate and so can provide a sustainable competitive advantage to the company (Martin de Castro *et al.*, 2011, Ray *et al.*, 2004).

According to the academic literature, IC is divided into three main components: human, structural and relational capital (Bontis, 1998, Edvinsson and Malone, 1997a). Several studies have shown that these components are deeply interrelated within organizations (Mouritsen *et al.*, 2001, Subramaniam and Youndt, 2005, Bontis, 1998). The interrelations between different IC components are expected to have a positive influence on the financial performance of the firm since the value of these IC components lies in their combined strength and not in their individual characteristics (Marr and Moustaghfir, 2005, Wang et al., 2014).

Previous studies have investigated the interrelations between individual IC components to determine which dimension of IC positively influences the others in the value-added creation

process or which contributes the most to corporate financial performance (Hsu and Wang, 2012, Martinez-Torres, 2006, Subramaniam and Youndt, 2005). Indeed, the knowledge embedded in one component can leverage the value of the knowledge in another component, since the combination of the two components results in a distinctive and indivisible resource that improves the financial performance of the company (Reed et al., 2006). Yet, the full set of interrelations between all three IC components is complex since their combination specifically allows companies to obtain a rare and valuable resource (Marr and Moustaghfir, 2005). The impact of IC components in combination is even more determinant when the business environment is changing, for example, during or following an economic downturn (Tseng *et al.*, 2013). Consequently, it is interesting to examine the full set of interrelations between IC components over a long period of time. The purpose of this study is to enhance knowledge about IC components by providing an inductive typology of their strategic interrelations. Indeed, typologies are a key way of organizing complex relationships and, thus provide useful tools for both researchers and practitioners (Delbridge and Fiss, 2013). In order to answer our research question, we conducted a content analysis of CEOs' letters to shareholders published by a sample of 122 companies from the top 200 in the *Fortune Global 500* from 2008 to 2012 in order to highlight the interrelations between the three IC components with respect to firm characteristics. The goal of a content analysis, defined as systematic and objective analysis of message characteristics, is to provide knowledge and understanding of the phenomenon under study (Bolden and Moscarola, 2000).

This study addresses several calls in the literature for research that enhances knowledge about the dimension of IC on which the theoretical construct is built (Marr and Moustaghfir, 2005, Petty and Guthrie, 2000). The typology provided by this research highlights the full complexity of interactions between IC components, expanding the current academic three-category classification of IC (Bontis, 1998, Marr and Moustaghfir, 2005). Furthermore, this

study enhances knowledge about interrelations between IC components over a five-year period, answering the need for longitudinal overview (Barney *et al.*, 2001, Youndt *et al.*, 2004, Martin de Castro et al., 2011).

The recent economic downturn has significantly increased budget constraints on the financial resources companies allocate to IC components. Yet firms face tougher competition in order to maintain or to improve their competitive advantage. Our research provides strategic managers with useful information about the complexity of the interrelations between IC component according to an evolving context, so that they can implement combinations of IC components that enhance the firm's financial performance (Dean and Kretschmer, 2007).

The remainder of this paper is organized as follows. The next section reviews the background literature on intellectual capital, followed by a description of the research method used to analyse the content of the CEOs' letters. After presenting our findings, we end with a discussion and concluding comments.

2. Literature review

The term intellectual capital (IC) is usually a synonym for intangible or knowledge assets (Stewart, 1991). The wide range of academic definitions of IC refer to an organization's total capabilities, knowledge capability, culture, strategy, process and professional practices, intellectual property and relational networks that create value or competitive advantages and help a company to achieve its goals (Edvinsson and Malone, 1997a, Bollen et al., 2005).

2.1 IC components classification

According to the academic literature, IC is divided into three main components: human, structural and relational capital (Bontis, 1998, Edvinsson and Malone, 1997a, Martin de

Castro et al., 2011). Human capital refers to employees' tacit or explicit knowledge, such as attitudes, experiences, aptitudes, skills, abilities, expertise and know-how. Human capital leaves the company at night when employees go home, so it does not belong to the company (Edvinsson and Malone, 1997b). It is a critical resource for differentiating financial performance between firms as it involves both knowledge stocks (hiring well-educated people) and knowledge flows (developing a high level of codified and tacit knowledge about a specific market and its specific market conditions) (Bontis, 1998). Unlike human capital, structural capital is everything left at the office at night when employees go home. It corresponds to the institutionalized knowledge and codified experience residing within and used by databases, patents, manuals, structures, systems and processes (Edvinsson and Malone, 1997b, Youndt et al., 2004). Structural capital is composed of the knowledge created by a firm's information technology systems and operating procedure (Edvinsson and Malone, 1997a), and of intangible elements like culture and informational routines (Nelson and Winter, 1982). Structural capital is divided into two components, technological and organizational (Martin de Castro et al., 2011). Technological capital refers to the combination of organizational knowledge directly linked to the development of the activities and functions of the organization's technical system. Technological capital includes investment in research and development, the technological infrastructure and intellectual and industrial property. Organizational capital is a combination of explicit or implicit intangible assets and gives cohesion to the different activities and business processes developed in the company. It includes culture, values and attitudes, information and telecommunications capability, and the organizational structure of the firm (Martin de Castro et al., 2011). Relational capital refers to organizational relationships with customers, suppliers, partners and social agents that are connected to the organization during its basic business processes, as well as the value of the firm's relations with stakeholders that can be influenced by the firm's activities (Nahapiet and

Ghoshal, 1998). Relational capital is defined as the organization's implicit set of available resources and ongoing relationships implemented through interactions between individuals or organizations (Kostova and Roth, 2003, Shipilov and Danis, 2006).

2.2 Interrelations between IC components

Several studies have shown that the dimensions of IC are deeply interrelated within organizations (Marr and Moustaghfir, 2005, Bontis, 1998, Subramaniam and Youndt, 2005). Indeed, individual knowledge (human capital) often becomes codified and institutionalized (organizational capital) and is transferred and leveraged in groups and networks (relational capital) (Subramaniam and Youndt, 2005). IC structure is organized around human capital as an input to organizational and relational capital while relational capital is often seen as an input to organizational capital (Bontis, 1998, Bontis, 1999, Bontis and Fitz-enz, 2002, Isaac *et al.*, 2010). Moreover, IC component deeply influence financial performance through organizational capital (Asiaei and Jusoh, 2015). Hence, IC components represent complementary resources since the value embedded in one component can leverage the value of other components, so that the combination of two components results in a distinctive resource that enhances company performance (Reed et al., 2006, Asiaei and Jusoh, 2015). Human capital builds structural capital that can be seen as the consequence of human creativity. Structuring human capital means that the company transforms its employees' know-how into a property of the company (Martinez-Torres, 2006, Bontis, 1998). Conversely, structural capital is considered as the embodiment, empowerment and supportive infrastructure of human capital (Edvinsson and Malone, 1997a). Indeed, structural capital derives its capabilities from employees in terms of the type of knowledge they possess and choose to store, and how they assimilate and use that knowledge. Furthermore, human capital can facilitate internal or external social connections, leading to better knowledge of best practices, customer needs and competitor moves (Yli-Renko *et al.*, 2001). Bringing together

highly qualified employees from different business departments, such as marketing, finance, management control, research and development or administration, can reduce the time and the investment needed to gather information (Hsu and Wang, 2012, Hsu et al., 2009). The environment is in constant change with the arrival of new competitors in the market, the launch of new products or services, and changes in the supply chain or product distribution. Therefore relations with clients, partners and allies evolve constantly, leading employees to develop new abilities, skills or knowledge (Reed et al., 2006, Davies, 2009).

Relational capital interacts with structural capital since it represents a certain kind of knowledge that facilitates inter-unit exchange and innovation, inter-firm learning, and cross-functional team effectiveness (Martin de Castro et al., 2011). Moreover, the relational capital of the firm enhances the quality of group work and the richness of information exchange among team members (Subramaniam and Youndt, 2005). Conversely, relational capital is defined as the knowledge embedded in the value chain of the organization. That is to say, the knowledge identified through the relationship of the organization with its suppliers, clients and entities outside the organization. Structural and relational capital represent conceptually distinct but complementary kinds of knowledge that facilitate inter-firm learning, inter-business-unit exchange and learning and cross-functional effectiveness (Hargadon and Sutton, 1997, Asiaei and Jusoh, 2015).

3. Methodology

In order to answer our research question (What is the full set of different interrelations between IC components?), we conducted a content analysis of the annual CEOs' letters to shareholders disclosed by our sample companies from 2008 to 2012. Indeed, content analysis

is considered as an adequate research method to examine organizational practices in managing and reporting IC (for a review see (Guthrie *et al.*, 2004)).

Our sample consisted of 122 of the first 200 companies in the *Fortune Global 500*, an annual ranking of the top 500 corporations worldwide measured by total revenue. Company selection was guided by different factors. First, IC components are seen as inputs to financial performance (Bollen et al., 2005, Tseng et al., 2013), which led us to select these financially wealthy companies. Second, the *Fortune Global 500* index has been used in previous research to study IC components (Somaya *et al.*, 2008, James, 2000). Third, the annual reports of these companies must include a CEO's letter for each of the five years covered by the study period (2008–12). This produced a final sample of 122 companies.

For each company, we collected the CEOs' letters to shareholders disclosed in companies' annual reports from 2008 and 2012. The studied period starts at the beginning of a significant economic downturn (2008) and lasts the whole period of this crisis. These major event may have significantly modified the interrelations between IC components over the period studied (Tseng et al., 2013). Since financial results of the companies are a precondition for the development of IC (Mouritsen, 2006), a contraction of these resources may have influenced the investment in IC.

For each company selected, we collected its *Fortune* rank year by year from 2008 to 2012 and computed its yearly evolution. In order to provide an in-depth analysis, we sorted the sample companies by geographical area (America (41), Europe (50) and Asia (31)), industry (Appendix A) and in terms of their rank in the *Fortune 500* (Appendix B). In order to analyse the interrelations between IC components and the strategic advantage they can provide, we then sorted companies according to their evolution in the *Fortune Global 500* ranking: positive, negative or equal.

The CEO's letter introducing a firm's annual report presents the main information and events of the past year, outlines past operating results, identifies new areas of potential corporate growth and profitability and is an essential means of communication between top management and shareholders (Bournois and Point, 2006, Kohut and Segars, 1992, Osborne *et al.*, 2001, Morris, 1994). Whether the authors of these letters are individuals or a collective of functional experts, these letters themselves are official documents that discuss themes important to the firm (Amernic and Craig, 2013). Furthermore, CEO answered numerous surveys concerning intellectual capital since they are they play a determinant role in the intellectual capital strategy of the firm (Subramaniam and Youndt, 2005, Hidalgo *et al.*, 2011). Since the goal of this study is to provide an inductive typology of the IC components interrelations, we proceed by a content analysis methodology that can be considered as a kind of typological analysis (Weber, 1990, Kabanoff *et al.*, 1995). Content analysis is used to identify the intentions and other characteristics of the communicator, reveal the focus of individual, group, institutional or societal attention, and describe trends in communication content (Brüggen *et al.*, 2009, Guthrie et al., 2004). Hence, the goal of a content analysis, defined as systematic and objective analysis of message characteristics (Neuendorf, 2001, Morris, 1994), is to provide knowledge and understanding of the phenomenon under study (Bolden and Moscarola, 2000). Given the high quantity of texts and the aim of meeting the reappropriability and replicability requirement, we selected the computer-aided approach as it reinforces face validity (Kabanoff et al., 1995). Computer-aided content analysis offers the opportunity to measure strategic intentions partially through analysis of the themes found in public statements by chief executives (Osborne et al., 2001). We used the SPAD-T.8.2 software, which provides useful frequency distributions of words, or words in context analysis and performs statistical analyses of textual data such as hierarchical cluster analysis (Franzosi, 2010). This software has been previously used in research that seek to provide typologies

(Lesage and Wechtler, 2012, Albertini, 2014). Furthermore, as a recording unit number of words has the advantage of being categorized more easily (Damak-Ayadi, 2010) and needs less subjective judgement on the part of the researcher (Gamerschlag *et al.*, 2011). In our study, content analysis is used as a quantitative research method, with textual data coded into categories and then described using statistics such as frequency counting that determines the relative importance of each categories.

Computer-aided content analysis comprises several steps. First, the computer generates a dictionary of all the words present in the database and their frequencies. Second, filter applications (removal of tool words such as certain verbs – like to have, to be – conjunctions and articles) make it possible to reduce the dictionary to main words. In the case of homonyms, the software allows us to consider the context in order to keep or remove a word. Third, a lemmatisation process allows us to identify the more complex forms in order to regroup in the same units the graphical forms that correspond to the different ways any one lemma can occur. Finally, a second elimination process removes words with low frequency to obtain a final dictionary of keywords.

To answer our research question, all the words related to notions of IC were kept in our final keywords dictionary. These keywords were classified under the three categories of IC (human, structural and relational capital) following currently adopted typologies (Reed et al., 2006, Edvinsson and Malone, 1997a, Bontis, 1998, Bontis, 1999, Martin de Castro et al., 2011). More specifically, the framework of this study incorporates the Brüggen et al (2009) framework and Vergauwen et al (2007) framework that have provided a classification of IC related terms collected by researchers in the World Congress on Intellectual Capital.

Once the dictionary was built, all statistical calculations were performed by SPAD-T.8.2 software. From contingencies tables (item*keywords) provided by the software, first, we ran a simple factorial correspondence analysis (FCA), with the yearly evolution in the ranking

(positive, negative or equal) as an active variable and other variables (industries, year, *Fortune* ranking, geographical areas) as illustrative variables in order to provide an inductive typology of all the interrelations between all the IC components. Second, this simple FCA is completed by a classification of keywords using a hierarchical cluster analysis. The use of these statistical methods makes it possible to carry out an exploratory study of the content of the texts (Guerin-Pace, 1998) and to present a typology of the significant keywords (Franzosi, 2010, Vergauwen et al., 2007).

4. Findings

Descriptive statistics

For each company of our sample, we compiled its annual *Fortune Global 500* rank, leading us to 610 observations over the period studied (2008–12). The yearly ranking evolution of our sample companies is positive for 263 observations (43.1% of the total), negative for 302 (49.5%) and equal for 33 (5.4%). During the period studied, the majority of the sample companies dropped less than 10 ranks (172 observations) or rose less than 10 ranks (155 observations) (see appendix B). The initial database contained 25,871 different words representing 894,281 occurrences. Following filter applications, lemmatization and elimination processes (removing words with a low frequency), we extracted a final dictionary of 111 different keywords representing 76,399 occurrences (8.54% of the initial vocabulary). The volume of disclosure remained relatively stable over the period, with a slight increase in 2010 and 2011.

Inductive typology of the IC components

From the contingencies table (item*keywords) provided by the software, we ran first, a simple correspondence analysis, with the yearly evolution in the ranking (positive, negative or

equal) as active variables and the other variables (industries, year, *Fortune Global 500* ranking, geographical areas) as illustrative variables in order to provide an inductive typology of the interrelations between the different IC components. This FCA led us to extract two factors representing 78.7% of the inertia. The first axis represents the negative evolution in the ranking while the second axis represents the positive evolution in the ranking.
Second, we proceed to a hierarchical cluster analysis based on the contingency lexical table generated five clusters of keywords presenting the full set of IC interrelations (Table 1). We check the validity of interpretation with the global Chi^2 test on the contingency table, significant at the 5% level.

Insert Table 1 about the Inductive typology of the IC components here

It is worth highlighting that the three IC components are all interrelated in two clusters representing 52.74% of the dictionary, while the IC components interact only two-by-two in the other three clusters, representing 47.26% of the vocabulary.

The most important cluster of keywords, representing 32.49% of the vocabulary, presents the interrelation of the three IC components in almost the same proportion. The keywords of this cluster refer to organizational capital through the notions of governance, structure and management together with the technological aspect of structural capital through the notions of manufacturing, technology, initiative or engine, among others. The words in context analysis show that companies mentioning the keyword ‘governance’ in the CEOs’ letters mainly associate it with the adjective ‘corporate’ or ‘culture’. They also refer to their high level of requirements regarding their corporate governance. The context of the keyword ‘structure’ mainly refers to organizational or cost structure, which has been adapted as a consequence of the economic downturn. Relational capital highlights the notion of agreement or alliance with

clients or partners while human capital refers to ability, knowledge or skills. Illustrative significant keywords in this cluster refer to the notions of ‘economic crisis’, ‘added-value’, ‘efforts’ and ‘performance’. In the context of economic crisis, companies mention the effort or investment they have had to make to create added value or to perform. This cluster, presenting an interrelation of IC components deeply embedded in the organization, is mainly composed of European or Asian companies ranked 1–40 in the *Fortune Global 500* with a positive evolution in the ranking during 2009.

The second cluster showing the interrelation between the three IC components represents 20.25% of the vocabulary. This cluster is significantly customer-oriented with the strong presence of relational capital, referring to the notions of commercial, customer, community, distribution and franchise. Organizational capital is represented through the notions of practices, commitment, model, or device and platform. When ‘commitment’ is mentioned in these CEOs’ letters, it refers to to a company’s involvement with its stakeholders, customers and partners. CEOs also highlight their concern that their companies’ core strategy will require all their human or financial resources. The reliance of these companies on the expertise and talent of their employees or teams is illustrative of the human capital component. The context of this cluster refers to the pressure companies have to face from shareholders, investors and the competition. These companies also mention ‘trust’, signifying their need to satisfy their clients and customers in a very competitive context.

This cluster, which presents a significantly customer-oriented interrelation of the three IC components, is mainly composed of North American companies that are ranked either 1–40 or 81–120 and with a negative evolution in the ranking.

The three other clusters present interrelations of two-by-two IC components centred around structural capital. The first of these three clusters, representing 19.24% of the vocabulary, shows the interaction of organizational capital, the main IC component, with relational capital and to a lesser extent human capital. Structural capital mainly refers to organizational capital through the concepts of award, coordination, programme and the history or culture of the companies. Where the keyword 'coordination' appears, companies mostly refer to the benefits of teamwork and good coordination between business units for successful projects. Technological capital identifies digital innovation as a marketing tool for companies that want to enhance customer knowledge. Relational capital is oriented towards the notions of connection, consumer, market, network and reputation, among others. The keyword 'connection' appears in the context of explicit references to companies' relationships with their customers, the community in which they work or civil society. The keyword 'network' often alludes to the network of subsidiaries, affiliates or partners that companies have established in order to improve their business efficiency. This cluster is mainly composed of North American companies, ranked 40–80 positions, with a negative evolution in the ranking.

The second of these three clusters, representing 18.22% of the vocabulary, shows the interrelation of relational capital (the main IC component) with structural capital and to a very limited extent human capital. In this class of keywords, relational capital refers to the notions of associate, contract, marketing, members and suppliers and is associated with the notions of combination or industrial discoveries. The keyword 'combination' mostly refers to the different factors that enhance company performance. These factors can be financial or organizational, for example lean sigma or quality management programmes. This class of keywords is deeply socially contextualized with the notions of CSR and eco-friendly. This

cluster consists of mainly European companies ranked 1–40 or 160 and above with a positive evolution in the ranking.

The final cluster of keywords, representing 9.81% of the vocabulary, shows the strong relationship between structural and relational capital. Structural capital refers to notions of infrastructure, policy, projects and synergies; technological capital mentions the concepts capacity, plant, process and research, which are significantly associated with notions of brand, cooperation, participants and stakeholders. Human capital is completely absent from this class of keywords. Companies in the middle of the *Fortune* ranking that improved their position during 2012 make up this cluster.

5. Discussion and conclusion

The aim of the paper is to present the full set of interrelations between the components of IC and expand the current academic typology of this topic.

Our typology highlights a full and fruitful set of interrelations and shows that CEOs focus on all the IC components and not just one or two individually. In our five-cluster classification, two clusters of keywords, representing the majority of the total keywords, present interactions between all three components (human, structural and relational capital). One of these two clusters of keywords is more customer-oriented and sits in a context of a negative yearly evolution for North American companies; the other one is more organization-oriented in a context of positive yearly evolution for European companies. These two clusters of keywords clearly illustrate that top managers that are in charge of the strategy of the company coordinate all three IC components in the different economic contexts they face. The three other clusters of keywords show different kinds of interaction between relational and structural capital mainly.

This five-cluster typology shows that CEOs consider IC component interrelations a contributive factor in their strategy. Contrary to Youndt *et al*. (2004), it seems that strategic managers focus on all three IC dimensions and combine them as necessary to maintain or improve their competitive advantage according to the different economic context. This classification confirms that IC components currently interact with each other in a complex set of interrelations (Martin de Castro et al., 2011, Hsu and Wang, 2012).

Relational and structural capital hold central positions in this typology. Indeed, these two IC components are deeply interrelated with each other in every cluster, leading us to confirm that relational capital cannot be separated from structural capital (Marr and Moustaghfir, 2005). Relational capital interacts differently with structural capital, depending on the economic

context. Indeed, relational capital is linked either to organizational capital or technological capital, allowing companies to take sustainable advantage of their customer and partner knowledge. Our results show that relational capital is a significant axis of company strategy, confirming this component as the most important of the three. Many firms are becoming involved in closer relationships with their suppliers in order to share practices, capabilities and information to develop new products faster and at a lower cost (Nahapiet and Ghoshal, 1998). In that context, a profound interaction between relational and organizational capital allows companies to gather useful information about customers and partners and to share it inside the company to enhance the efficiency of a customer-oriented strategy (Murthy and Mouritsen, 2011, Hsu and Wang, 2012). Moreover, a deep interaction between relational and technological capital allows companies to develop new products. Indeed, relational capital can have a positive influence on the innovation process because of employees' cooperative way of working.

Our results show a weak interaction of human capital with the other IC components. Indeed, human capital is interrelated with relational or structural capital in only three clusters of the five. It seems that contrary to previous research (2002, Bontis, 1998, Bontis, 2004), human capital does not hold a central position in this IC components typology. The economic context of this study can explain these results to some extent. Companies often replace human capital with technological capital in order to reduce their production costs or to improve productivity (Murthy and Mouritsen, 2011). In an economic downturn, companies are particularly tempted to rationalize their production process through collective dismissal (Tseng et al., 2013). Furthermore, strategic managers and financial analysts still consider human capital as a cost rather than capital. Most accounting standards consider human resources as an expenditure that features in the income statement rather than in the balance sheet. Finally, human capital belongs to individual employees who can leave the company while organizational capital

belongs to the company. These issues may explain why strategic managers do not associate human capital with the other IC components to any great extent.

The evolution of the full set of interrelations between IC components during the period studied may be due to the financial pressures experienced by the companies during the economic crisis. Numerous previous studies have proved that IC enhances a company's financial performance (Tseng et al., 2013, Bollen et al., 2005). Yet the return on investment of IC is difficult to measure since there is a delay between investment in IC and its financial profit for the company. Furthermore, IC is intangible; it has no physical substance, which makes it hard to delimit and manage. Hence, the characteristics of the IC components clusters that we have identified clearly illustrate that financial performance is an additional input to IC. Indeed, companies that have a positive evolution in the ranking mention IC components interrelations based mainly around the structural capital, more specifically the technological one, and the relational capital. Those companies rely on innovations and research and development activities jointly with relationships with their partners and associates on a collaborative way of working. The technological capital is one of the most tangible IC components leading companies to rely on it since its tangible characteristic allows an easier estimation of the return on investment. In contrary, companies that have a negative evolution in the ranking, mention IC components interrelations based mainly around the relational capital and to a lesser extent the structural capital. For those companies, the relational capital focused mainly on the clients or customers in interaction with the organizational capital. Since, these companies have faced a negative evolution in the Fortune Ranking, we can wonder to what extent the economic crisis has influenced these IC components interrelations following Murthy and Mouritsen (2011).

This study has important contributions for researchers and practitioners. It contributes to the academic literature by showing that the full set of interrelations between IC component is

more complex than presented in previous academic studies (for a review, see (Martin de Castro et al., 2011). Contrary to previous a priori classification, our business practices-oriented framework shows that all the three IC components interact together and not just two by two. It reveals that top managers that are in charge with the strategy combine IC components differently depending on the situation faced by the company. This research highlights that relational capital interacting with structural capital holds a central position in companies' business strategy. This study provides deep insights into the interrelations between IC components that can significantly help managers to identify the strategic connections between IC dimensions. Relational capital interacting with structural capital is seen by managers to be a strategic means to gain, maintain or restore a company's competitive advantage company. Since these interactions between the different components of IC lead to sustainable competitive advantage, managers must develop tools to measure and manage the return on investment of these interrelations (Herremans *et al.*, 2011). Even if the profitability of these interactions is difficult to measure, managers should take advantage of these them as part of a strategic goal.

There are some limitations to this research. Our study is based on CEOs' letters published in firms' annual reports and presents a more financial perspective, since the main readers of these letters are shareholders. Furthermore, some of the CEOs of these companies changed during the study period, which may have modified the management of IC components from a strategic perspective.

This research provides some interesting avenues for future study. First, our results highlight the interrelations between different IC components by geographical area. Interrelations are more customer-oriented in North American companies than in Asian companies, where the structural capital holds the central position. These results confirm that cultural diversity has a significant impact on IC developments (Chaminade and Roberts, 2003, Bontis, 2004). More

contextualized research could usefully study these cultural differences. Second, qualitative research should study the management of IC components since our results show that their interrelations are multiple and complex. Indeed, IC appears to be a managerial challenge as well as a solution (Murthy and Mouritsen, 2011). Case studies could significantly enhance knowledge of the management of these IC components and their interrelations.

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Table 1: Inductive typology of the IC components

Main characteristic of the cluster	**Interaction of the three components of IC embedded in the company** (32.49%)	**Interaction of the three components of IC customer oriented** (20.25%)	**Organizational capital interacts with relational capital** (19.24%)	**Relational capital interacts with structural capital** *(18.22%)*	**Structural capital interacts with relational capital** (9.81%)
Structural capital	*OC*: governance, management, structure *TC*: engine, initiative, manufacturing, technology, devices	*OC:* commitment, model, practices *TC*: devices, platform	*OC*: award, coordination, culture, history, organic, program *TC:* design, digital, innovation	*OC*: combination *TC*: discoveries, industrial,	OC: infrastructure, policy, projects, synergies TC: capacity, plant, process, research
Relational capital	agreement, alliance, clients, exchange, partners, relationships	commercial, communication, community, customer, distribution, clients	connection, consumer, market, network, prospects, purchase, reputation	associate, contract, marketing, members, suppliers	brand, cooperation, participants, stakeholders, stores
Human capital	ability, creation, employer, knowledge, skills	employees, expertise, talent, team	collaborate, colleagues, imagination	training	
Companies' <u>most</u> represented characteristics	<u>Positive yearly evolution</u> Financial services & insurance; automotive; telecom & IT Asia, Europe	<u>Negative yearly evolution</u> Telecom & IT; financial services & insurances North America	<u>Negative yearly evolution</u> Pharmaceutical; telecom & IT; North America;	<u>Positive yearly evolution;</u> Energy & chemicals; industrial products; automotive; food-beverage & retail Europe	<u>Positive yearly evolution</u> Energy & chemicals; food-beverage-retail; industrial products Asia
Companies' <u>least</u> represented characteristics	<u>Negative yearly evolution</u> Energy & chemical; food-beverage & retail; pharmaceutical North America	<u>Positive yearly evolution</u> Energy & chemicals; automotive; industrial products Europe; Asia	<u>Positive yearly evolution</u> Energy & chemical; financial services & insurance; automotive; industrial product Asia	<u>Negative yearly evolution</u> Financial services & insurance; pharmaceutical; telecom & IT; North America	<u>Negative or equal yearly evolution</u> Telecom & IT; financial services & insurance North America

APPENDIX A: Industrial sector sample

Industrial sector	*n* (observations)	% of the total
Automotive	50	8.2
Energy and chemicals	125	20.5
Pharmaceuticals	70	11.5
Financial services and insurance	130	21.3
Food-beverage-retail	60	9.8
Industrial products, services and logistics	90	14.8
Telecom-IT-technology	85	13.9
Total	610	100

APPENDIX B: Yearly evolution

Yearly evolution	*n* (observations)	%
From 0 to +10	155	25.4
From +11 to +20	61	10
From +21 to +30	32	5.2
From +31 to +40	9	1.5
From +41 to +50	12	2
From +51 to +70	9	1.5
From +71 to +90	6	1
More than +100	10	1.6
From -1 to -10	172	28.2
From -11 to -20	64	10.5
From -21 to -30	32	5.2
From -31 to -40	17	2.8
From -41 to -70	9	1.5
From -71 to - 90	8	1.3
From -91 to more than -100	6	1
New	8	1.3
Total	610	100