THE INFLUENCE OF INTELLECTUAL CAPITAL ON ABSORPTIVE CAPACITY AND PRODUCT INNOVATION

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ABSTRACT

This paper aims to investigate the influence of intellectual capital on absorptive capacity (ACAP) of firms, as well as the influence of ACAP on innovation. The theoretical argument of this thesis is based on the Resource Based View, which assumes that sets of intangible assets such as intellectual capital are mobilized by firms through dynamic capabilities such as absorptive capacity, leading to results such as product innovation. Using the quantitative approach the study covered 500 industries in southern Brazil of different sizes, sectors and technological intensities. Using the method of structural equation modeling, the examination of adjustment indexes and statistical significance confirmed the validity of all the constructs and model. It also served to support or refute the hypotheses of the study. Given the evidences, it can be concluded that the intellectual capital influences absorptive capacity, but the elements that compose the intellectual capital reflect differently on the dimensions of ACAP. The capabilities of acquisition, assimilation and exploitation of knowledge are influenced more decisively by organizational capital, followed by human capital. The ability of transformation of knowledge is influenced evenly by organizational and human capital, and more moderately by social capital. In turn, the absorptive capacity influences innovation, and each of its dimension has a different impact. Knowledge acquisition and exploitation have a more intense influence.

Keywords: absorptive capacity; intellectual capital; innovation.

1 INTRODUCTION

The fact that firms are seen as active agents in the process of knowledge absorption leads to the assumption that the innovative performances of such organizations are also outstanding. Several studies have shown that ACAP may be an important aspect to help us understand why knowledge is asymmetrically used to produce innovation (Lane, Koka, & Pathak, 2006; McCann & Folta, 2008; Van Den Bosch, Wijk, & Volberda, 2003). Furthermore, a positive relationship has been found between ACAP and technological innovation (Tsai, 2001) and product innovation (Fosfuri & Tribó, 2008).

But companies have different levels of capacity to innovate because their capacity to absorb knowledge is different. At the same time, firms do not have the same level of ACAP because a number of resources makes every firm unique (Jansen, Van Den Bosch, & Volberda, 2005; Nieto & Quevedo, 2005; Subramaniam & Youndt, 2005). The Resource Based View offers an analysis of a firm considering its internal resources, which are viewed as key factors for innovation. Thus, a firm outperforms the others because of its competences, that is, its capacity to produce a unique combination of tangible and intangible resources (Barney, 1991; Barney & Hesterly, 2004). Resources are isolated but complementary, and if they have a systemic capacity to create interaction networks, they tend to generate sustainable competitive advantages.

Dynamic capabilities are organizational and strategic routines by which firms can reconfigure their resources in changing environments, thus being a source of sustainable competitive advantage (Eisenhardt & Martin, 2000; Teece, Pisano, & Shuen, 1997). In this sense, a strong synergy with the internal resources of the firm, such as intellectual capital, is required to make sure that ACAP provides sustainable competitive advantage based on the production of innovation.

However, while most studies have focused on the competitive advantages of ACAP, the resources and factors necessary for the development of ACAP have been often overlooked (Jansen et al., 2005; Lane et al., 2006; Zahra & George, 2002). Therefore, there is need for further research on the relationship between ACAP and the internal resources of firms, including intellectual capital. Although the capacity to absorb external knowledge may bring significant benefits, resources may have different effects on the dimensions of ACAP, thus leading to different results of innovation and performance. However, even when internal resources have been considered (Lane, Salk, & Lyles, 2001; Van Den Bosch, Volberda, & De Boer, 1999), their relationships with the different dimensions of ACAP have not been empirically tested. This has been confirmed by the fact that we could only find a few studies showing a theoretical discussion of the relationship between some resources and ACAP, or testing the relationship between some resources and the different dimensions of ACAP without definitive results (Daghfous, 2004; Fosfuri & Tribó, 2008; Jansen et al., 2005; Lane et al., 2001; Schimidt, 2005; Van Den Bosch et al., 1999). Jansen et al. (2005) and Fosfuri and Tribó (2008) investigated these relationships and found that some resources have a different influence on the dimensions of ACAP.

Van Den Bosch et al. (2003) agree that there have not been significant contributions to the measurement of ACAP. These authors claimed that the internal resources that have an influence on ACAP deserve to be further investigated considering their impact. Espinosa, Pelaez, Gimenez, and Guzman (2007) indicated that a large gap consists of the absence of a

model to rank the aspects that have an influence on ACAP. Such model should briefly describe the relationships between these aspects and the time when each one of them is important.

With the purpose of increasing our knowledge on this topic, further studies should be conducted on the resources required so that ACAP can be developing in an effective manner. Therefore, we conducted the present study with the purpose of reducing this knowledge gap on the internal intangible resources that have an influence on ACAP leading firms to innovate. To that end, this paper aims to investigate the influence of intellectual capital on absorptive capacity (ACAP) of firms, as well as the influence of ACAP on innovation. Using the quantitative approach and the method of structural equation modeling, the study covered 500 industries in southern Brazil of different sizes, sectors and technological intensities.

2 ABSORPTIVE CAPACITY: CONCEPTS AND DIMENSIONS

The concept of "absorptive capacity" was first defined by Cohen and Levinthal (1989). In 1990, these authors expanded the definition as "a firm's ability to recognize the value of new information, assimilate it, and apply it to commercial ends" in a strategic manner and based on innovation, proposing a model (Cohen & Levinthal, 1990). After the original definition by Cohen and Levinthal, few studies have attempted to expand and elaborate on this definition and its dimensions. Zahra and George (2002) adopted a more procedural perspective on ACAP and argued that effectively sharing internal knowledge and integration are key factors of such capacity, thus showing the importance of internal resources. According to these authors, ACAP is a multidimensional construct consisting of a set of organizational routines and processes by which firms produce an organizational dynamic capability that combines four different and complementary capacities of knowledge.

These dimensions are presented next. Acquisition of knowledge: the firm's capacity to recover, identify, and acquire external knowledge that is critical to the company's operations. Assimilation of knowledge: the firm's capacity to analyse, process, interpret, and understand the information obtained from external sources. Transformation of knowledge: the firm's capacity to recognize two sets of seemingly incongruous information and then combine them to reach a new scheme. Exploitation of knowledge: the firm's capacity to refine, expand, leverage, and create existing skills, these are processes focused on application of knowledge (Cohen & Levinthal, 1990; Gold, Malhotra, & Segars, 2001; Todorova & Durisin, 2007; Zahra & George, 2002). When a firm is able to analyse and improve its ACAP, it renews its knowledge base, which influences the performance through innovation of products and processes. This also makes firms more flexible when it comes to using resources and capabilities, thus creating competitive advantage.

However, some factors are important to reach successful ACAP (Cohen & Levinthal, 1990; Espinosa et al., 2007; Fosfuri & Tribó, 2008; Jansen et al., 2005; Todorova & Durisin, 2007; Zahra & George, 2002). There are two different research lines. One of them is focused on characteristics of external knowledge, more closely related to partners. The other line is focused on the internal characteristics of an organization, such as resources (Lane et al., 2006). The the internal factors include tangible resources, such as company size and financial investment in R&D, and intangible resources, such as basic skills and problem solving methods, experience and learning skills, common language, which refer directly to the internal aspects of the organizations (Cohen & Levinthal, 1990). Several authors have stressed the importance of the influence of internal factors related to employees, organizational profile,

and internal relationships on ACAP (Daghfous, 2004; Espinosa et al., 2007; Lane et al., 2006; Minbaeva, Pedersen, Bjorkman, Fey, & Park, 2003; Schimidt, 2005; Zahra & George, 2002). Therefore, several factors that have an influence on ACAP are related to intellectual capital.

3 INTELLECTUAL CAPITAL: CONCEPTS AND DIMENSIONS

Intellectual capital is linked to a firm's capacity to create and apply its knowledge base, basically consisting of three characteristics: (a) its intangibility; (b) its potential to create value; (c) the effect of growth of corporate practices and synergies (Dean & Kretschmer, 2007). A consensual and universal definition of intellectual capital cannot be reached; however, most authors seem to agree that intellectual capital is a multidimensional concept useful to describe the knowledge assets of a company and how these assets changed or are expected to change over time. The closest we could get of any unifying model of the different aspects of intellectual capital is a model based on the general acceptance of three categories: (a) human capital; (b) organizational capital; (c) social capital.

Human capital is related to the employees' tacit or explicit knowledge, as well as their ability to generate useful knowledge for the company. It also includes individual values, behaviors, and attitudes; education and training; experiences and skills, and know-how (Cabrita & Bontis, 2008; Delgado-Verde, Martin-De-Castro, Navas-López, & Cruz-Gonzáles, 2011; Edvinsson & Malone, 1998; Martín-de-Castro et al., 2011; Subramaniam & Youndt, 2005). Other examples are creativity, employees' flexibility, tolerance of ambiguity, motivation, satisfaction, learning capacity, loyalty, formal training, and education.

Organizational capital can be defined as everything that remains in the company when employees go home (Edvinsson & Malone, 1998). According to Martín-de-Castro et al. (2011), this may seem simple, but this concept has important differences and strategic implications. If we consider that human capital belongs to the employees, organizational capital is owned and managed by the company. This capital can be seen as the tools and the architecture provided by an organization to retain and transfer knowledge throughout its business activities (Cabrita & Bontis, 2008). This capital includes organizational culture, values and attitudes; capacity and commitment to make effective use of information and telecommunications technologies to ensure information storage, disclosing, absorbing, transferring, and refining useful information and knowledge across the whole company; and organizational structure, which is related to the formal mechanisms used to organize the company (Delgado-Verde et al., 2011; Hsu & Fang, 2009; Martín-de-Castro et al., 2011).

Social capital is defined as the knowledge embedded within the organizations, which is available and used through interactions between individuals and their interrelationship networks (Nahapiet & Ghoshal, 1998). This capital plays an important role in facilitating the acquisition and creation of knowledge by organizations and, it allows some companies to have advantages over the others. Social capital is the knowledge embedded within the firm in a collective manner. It becomes available through interactions between individuals, work groups, and their social networks, but without the formality and rigidity of organizational capital (Subramaniam & Youndt, 2005).

Each of these aspects of intellectual capital requires unique types of investments. Human capital requires hiring, training, and retention of employees, in addition to management practices that appreciate subjectivity and creativity. Organizational capital requires the creation of methods of knowledge storage and a plan for recurrent practices, in

addition to strategies and organizational culture that value communication and knowledge. Finally, social capital requires the development of standards to facilitate interactions, relationships, and collaboration between and within different departments. Therefore, the different aspects of intellectual capital have an influence on ACAP and organizational outcomes, including product innovation.

4 RESEARCH MODEL

Our model was developed based on the Resource Based View to support the main concepts of the research, such as resources, capacities, and dynamic capabilities, which are directly related. ACAP, as a dynamic capability, uses intangible resources that make up intellectual capital to achieve organizational goals related to knowledge.

Investments in intangible resources are associated with the firm's results, particularly with regard to sustainable competitive advantage and innovation (Wu, Chang, & Chen, 2008). Several empirical studies concluded that the intangible factors of a firm have a more significant influence on the results of innovation (Carmeli, 2001; Fernández et al., 2000; Reed, Lubatkin, & Srinivasan, 2006; Subramaniam & Youndt, 2005). In turn, ACAP is a moderator of organizational results (Van Den Bosch et al., 2003), allowing for the mobilization of intellectual capital and leading firms to different innovative performances.

In addition, the different elements that make up intellectual capital (human capital, social capital, and organizational capital) may have different effects on the dimensions of ACAP (acquisition, assimilation, transformation, and exploitation) and subsequently lead to different results of innovation and performance. Jansen et al. (2005) and Fosfuri and Tribó (2008) investigated these relationships and found that some factors have a different influence on the dimensions of ACAP.

Lane et al. (2006) focused on the original proposal by Cohen and Levinthal (1990) and suggested that individual cognition is a key internal factor of ACAP. Several authors agree with this (Daghfous, 2004; Espinosa et al., 2007; Minbaeva et al., 2003; Schimidt, 2005). The more education and training an employee receives, the greater its individual capacity to assimilate and use new knowledge (Minbaeva et al., 2003; Schimidt, 2005). Daghfous (2004) stated that the diversity of individual experiences and knowledge increases the chance of new knowledge to be something related to the existing knowledge in the company, thus facilitating its assimilation.

The role of the organizational structure to facilitate knowledge transfer and absorption is an important element according to Cohen and Levinthal (1990). Lane and Lubatkin (1998), Van Den Bosch et al. (1999) and Espinosa et al. (2007) argued that different types of structures have different effects on ACAP. Jansen et al. (2005) found that organizational mechanisms associated with coordination capacities enhance the acquisition and assimilation of new external knowledge. Espinosa et al. (2007) reinforced that systemic capacities, i.e., system abilities related to the standardization of internal working procedures and guidelines used to integrate explicit knowledge also have an influence on ACAP.

Jansen et al. (2005) showed that socialization is positively related to transformation and exploitation, especially the density of connections between the members of the organization, including trust and cooperation, thus facilitating these capacities. Nevertheless, Fosfuri and Tribó (2008) found that knowledge acquisition and assimilation are also influenced by these mechanisms. In this sense, Todorova and Durisin (2007) claimed that the

mechanisms of social integration are present in all stages of absorption of knowledge, but they have different types of impact on ACAP.

In this sense, intellectual capital, as an intangible resource, has an impact on ACAP. We may then raise the following hypothesis: *Hypothesis 1. Intellectual capital is positively related to ACAP*. Based on the above, Hypothesis 1 can be split into twelve other hypothesis if we correlate each element that makes up intellectual capital with each dimension of ACAP.

The fact that firms are seen as active agents in the process of knowledge absorption leads to the assumption that the innovative performances of such organizations are also outstanding. According to Lane et al. (2006), several studies have shown that ACAP positively affects the companies' innovativeness. McCann and Folta (2008) pointed out that, although there are other elements that can lead to different innovative performances, such as characteristics of management, size, and time since the firm was established, ACAP may be an important element to understand the differences in the use of knowledge. Studies such as the one by Tsai (2001) corroborated this statement because they connected ACAP to innovation, especially technological innovation and competitive performance.

Fosfuri and Tribó (2008) specifically investigated the capacity of firms to recognize external knowledge and then adapt it to their organizational routines to stimulate innovations. On the influence of potential ACAP (acquisition and assimilation) on innovative performance, these authors found that these abilities have a positive and highly significant relationship with product innovation. Zahra and George (2002) explained that assimilation refers to the knowledge that an organization can interpret and understand based on the existing cognitive structures. Such knowledge is located in the research area of the firm, being compatible with the existing context, and involving additional resources closely related to its prior knowledge. Todorova and Durisin (2007) argued that transformation of knowledge is not a consequence of assimilation, but it may represent an alternative process. Transformation makes it possible for organizations to notice new knowledge that is to some extent incompatible with their prior knowledge in order to build new cognitive structures and deal with path dependency. Therefore, if the cognitive structures of an organization are different, they may influence innovation in different ways.

Thus, different levels of ACAP lead to different results of innovation, leading to the following hypothesis: *Hypothesis 2. ACAP is positively related to product innovation.* On the basis of the above, Hypothesis 2 can be split into four other hypothesis if we correlate every dimension of ACAP (acquisition, assimilation, transformation, and exploitation) with innovation.

5 METHOD

Industrial companies are useful to measure product innovations and their variability makes it possible to perform the necessary statistical tests. With the purpose of maximizing this variation and increasing the generalizability of the results, we decided to include a population of 10,838 industrial companies registered with the Federation of Industries of Rio Grande de Sul - FIERGS. These companies had different sizes, were located in different regions, and manufactured different products.

Based on this population, the sample include 500 cases, according to the recommendations of Hair, Anderson, Tatham, and Black (2005) for the adequacy of the necessary calculations. To increase accuracy, we decided to use a stratified sample, using two

stratification variables: company size and technological intensity of the industry. The industries were rated according to the National Register of Economic Activities (CNAE). Because the technological intensity rating of the OCDE has been criticized by some authors (Mendonça, 2009), we used the rating suggested by Furtado and Carvalho (2005), since the sectors of Brazilian industry have different patterns of technological efforts when compared with developed countries (Table 1). The elements were allocated into each stratum using simple random sampling.

TABLE 1: Sample Characteristics

		Technological intensity			
		Low	Avg. Low	Avg. High	High
Firm size	Micro	48	14	26	37
	Small	63	12	37	17
	Medium	61	39	51	17
	Big	37	12	18	11

The data include a combination of questionnaires and secondary sources of FIERGS and CNAE. Different key informants were used for obtaining survey information. Interviews were conducted in 2014 using the key informant technique. The key informant was the companies CEO and president, and directors of human resources and P&D. An analysis of respondents and non-respondents showed no differences in industry membership, number of employees, and revenues.

The measurement instrument was developed using a multi-item scale (seven-point Likert-type scale), according to previous studies. Nomological validity was ensured by the constructs previously tested in other studies, such as those by Flatten, Engelen, Zahra, and Brettel (2011) and Subramaniam and Youndt (2005), among others. The instrument was previously assessed by six experts, with PhD in business administration and researchers of knowledge and innovation. We conducted two tests with 33 MBA students who work directly in the management of different industrial companies and directors of 32 companies of different size and technological intensity. Thus, the instrument was refined, reaching the final version.

The constructs and variables that make up ACAP were identified by Flatten et al. (2011) based on a study of 269 articles published between 1990 and 2007 in journals strongly focused on management, including studies related to ACAP. The constructs and variables that make up intellectual capital is based on Subramaniam and Youndt (2005); Davenport and

Prusak (1998); Gupta and Govindarajan (2000); Nahapiet and Ghoshal (1998); Schultz (1961); Snell and Dean (1992) and Walsh and Ungson (1991). Regarding ACAP results, we considered product innovation that, besides being the focus of industrial companies, provides a degree of tangibility for innovation that becomes more evident (Knight, 1967; Romijn & Albaladejo, 2002; Utterback & Abernathy, 1975). Hagedoorn and Cloodt (2003) advocate the use of multiple indicators to measure innovation. Therefore, with the purpose of measuring innovation, we used indicators based on the studies by Caloghirou, Kastelli, and Tsakanikas (2004), Fosfuri and Tribó (2008), Hagedoorn and Cloodt (2003), Jantunen (2005), Kafouros, Buckley, Sharp, and Wang (2008), Nieto and Quevedo (2005), and Romijn and Albaladejo (2002).

Figure 1: Constructs and variables of the analysis model

Constructs	**Variables**
Human capital	Our employees are highly skilled.
	Our employees are widely considered the best in our industry.
	Our employees are creative and bright.
	Our employees are experts in their particular jobs and functions.
	Our employees develop new ideas and knowledge.
Social capital	Our employees are skilled at collaborating with each other to diagnose and solve problems.
	Our employees share information and learn from one another.
	Our employees interact and exchange ideas with people from different areas of the company.
	Our employees partner with customer suppliers, alliance partners, etc., to develop solutions.
	Our employees apply knowledge from one area of the company to problems and opportunities that arise in another.
Organizational Capital	Our organization uses patents and licenses as a way to store knowledge.
	Our company incorporates much of its knowledge in the processes and practices.
	Much of our company's knowledge is contained in manuals and databases.
	Our company values the internal dissemination of information and the flow of knowledge.

	Our company facilitates communication and exchange of information among employees.
Acquisition	The search for relevant information concerning our industry is every-day business in our company.
	Our management motivates the employees to use information sources within our industry.
	Our management expects that the employees deal with information beyond our industry.
Assimilation	In our company ideas and concepts are communicated cross-departmental.
	Our management emphasizes cross-departmental support to solve problems.
	In our company there is a quick information flow.
	Our management demands periodical cross-departmental meetings to interchange new developments, problems, and achievements.
Transformation	Our employees have the ability to structure and to use collected knowledge.
	Our employees are used to absorb new knowledge as well as to prepare it for further purposes and to make it available.
	Our employees successfully link existing knowledge with new insights.
	Our employees are able to apply new knowledge in their practical work.
Exploitation	Our management supports the development of prototypes.
	Our company regularly reconsiders technologies and adapts them according to new knowledge.
	Our company has the ability to work more effectively by adopting new technologies.
Innovation	The product innovations introduced between 2008 and 2012 allowed our company to increase its market share.
	The amount of product innovations developed by our company between 2008 and 2012 is higher than that of our competitors.
	The percentage of sales from product innovations developed by our company between 2008 and 2012 is higher than that of our competitors.

Numerous organizational factors beyond intellectual capital and ACAP may influence innovation. Thus, were used control variables of organizational environment and industry

environment. Size was measured as the number of fulltime employees. R&D spending was calculated as an organization's yearly R&D expenditures divided by its annual sales. Dynamism was measured as the standard error of the regression slope coefficient divided by the mean sales value.

6 RESULTS

Statistical analysis was performed using SPSS®19.0 and AMOS®19.0. Preliminary analysis included evaluation of outliers (Z values and Mahalanobis distance); evaluation and treatment of missing data; univariate normality (Skewness, Kurtosis, Kolmogorov-Smirnov, Shapiro-Wilks); multivariate normality (Mardia coefficient); homoscedasticity (Box M); multicollinearity (Pearson correlation coefficient). Because linearity is included in the multivariate analysis, it is shown later. Based in the tests, 495 cases were considered to be valid, representing a wide range of organizational characteristics.

As anticipated, some of our control variables exhibited significantly different effects across the variables. R&D spending and industry dynamism was positively related to intellectual capital, ACAP and innovation.

Based on the confirmatory factor analysis, three variables were excluded from the model (SC09, OC11, OC13) due to low z-values, low factor loading, high shared variance, and non-normal distribution in the initial tests (Bagozzi & Baumgartner, 1994). Covariance was inserted between the variables SC8 and SC10 and between the variables HC2 and HC5 because these variables belong to the same construct and are directly related (Anderson & Gerbing, 1988; Bagozzi & Baumgartner, 1994; Raykov & Marcoulides, 2000). After these inclusions, the model indexes were higher than or close to 0.90, within the standards accepted in the literature.

All values obtained for composite reliability were above 0.7 (human capital = 0.916; social capital = 0.905; organizational capital = 0.864; acquisition = 0.901; assimilation = 0.903; transformation = 0.949; exploitation = 0.882; innovation = 0.928). In terms of average variance extracted, all values were above 0.5 (human capital = 0.686; social capital = 0.709; organizational capital = 0.694; acquisition = 0.752; assimilation = 0.703; transformation = 0.823; exploitation = 0.714; innovation = 0.724). Convergent validity and discriminant validity were also assessed using the Fornell-Larcker criterion (Fornell & Larcker, 1981). The constructs assimilation and acquisition seemed to converge, and we decided to test them based on the criterion of Bagozzi and Phillips (1982). Both constructs were proven to be significantly different.

In order to develop the structural model, we suggested two new covariances between the variables As19 and As20 and between the variables Tr23 and Tr24. These suggestions were accepted because these variables belong to the same construct and their topics are clearly related. Similarly, the modification indexes suggested the insertion of correlation between the constructs of intellectual capital: human capital, social capital, and organizational capital. According to Bagozzi and Baumgartner (1994), unpredicted associations in the theoretical model may be inserted when necessary so that relevant relationships between the constructs do not fail to be detected. Even though the model had good fit without the inclusion of this change, we found that the relationship between the elements that make up intellectual capital was important and decided to insert it. After these changes, the adjustment

indexes of the structural model were higher than or close to 0.90, within the standards accepted in the literature.

TABLE 2: Measurement and Structural Model

Variables	Measurement	Structural
$\chi^2(gl)$ - Qui-Squared (degrees of freedom)	10098.083(347)	999.309(353)
χ^2/gl	3.165	2.23
p - significance	0.000	0.000
RMSEA - Root Mean Squared Error of Approximation	0.066	0.061
GFI - Good Fit Index	0.866	0.877
AGFI - Absolut Good Fit Index	0.832	0.848
CFI - Comparative Fit Index	0.921	0.932
NFI - Normed Fit Index	0.889	0.899
TLI - Tucker-Lewis Coefficient	0.907	0.922
Alpha de Cronbach	0.951	
Compound reliability	0.955	
AVE - Average Variance Extracted	0.725	

Based on the good fit of the model, the parameters estimated for each relationship and the acceptance or rejection of the study hypotheses are presented.

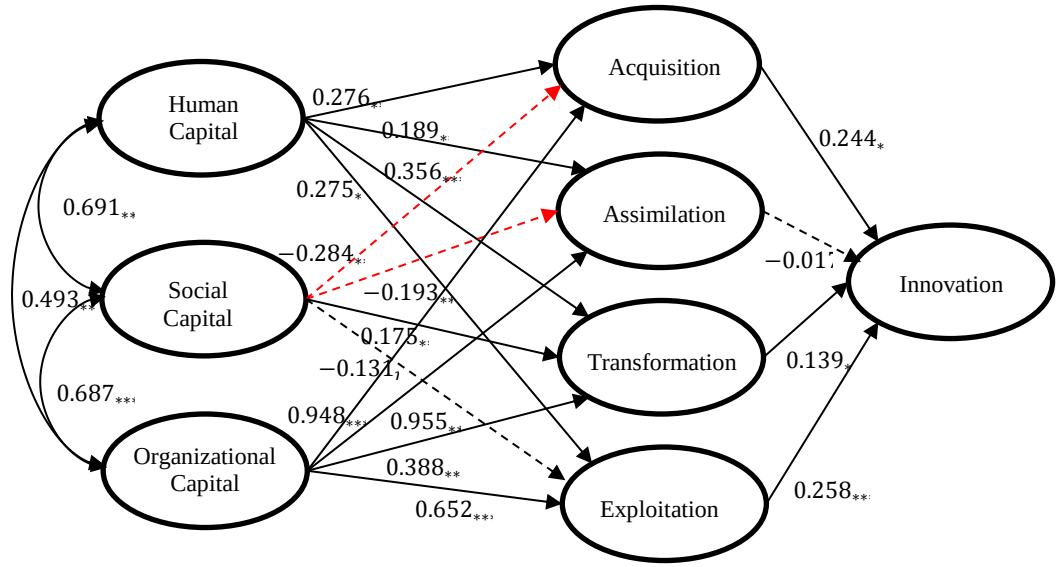
TABLE 3: Hypothesis testing

Hypothesis	CFP (*z-values*)	Std. error	*p*	Result
H1a- Human Capital →Acquisition	0.276(4.710)	0.053	0.000	Accepted
H1b - Human Capital →Assimilation	0.189(3.446)	0.058	0.000	Accepted
H1c - Human Capital →Transformation	0.356(6.374)	0.059	0.000	Accepted
H1d - Human Capital →Exploitation	0.275(4.098)	0.056	0.000	Accepted
H1e- Social Capital →Acquisition	-0.284(-3.795)	0.088	0.000	Rejected

H1f - Social Capital → Assimilation	-0.193(-2.792)	0.095	0.005	Rejected
H1g - Social Capital → Transformation	0.175(2.638)	0.091	0.008	Accepted
H1h - Social Capital → Exploitation	-0.131(-1.605)	0.088	0.108	Rejected
H1i- Organizational Capital → Acquisition	0.948(14.544)	0.064	0.000	Accepted
H1j - Organizational Capital → Assimilation	0.955(12.838)	0.085	0.000	Accepted
H1k - Organizational Capital → Transformation	0.388(7.496)	0.059	0.000	Accepted
H1l - Organizational Capital → Exploitation	0.652(9.581)	0.061	0.000	Accepted
H2a- Acquisition →Innovation	0.244(2.121)	0.116	0.034	Accepted
H2b - Assimilation → Innovation	-0.017(-0.149)	0.098	0.881	Rejected
H2c - Transformation → Innovation	0.139(2.260)	0.053	0.024	Accepted
H2d - Exploitation → Innovation	0.258(3.626)	0.078	0.000	Accepted

The structural model is shown in Figure 2, including the significant positive and negative relationships and the rejected relationships.

FIGURE 2: Final Structural Model



Legend:

Suggested relationship confirmed in the model.
Suggested relationship rejected in the model.
Suggested relationship inserted in the model.

Human capital is related to knowledge, mental models, experiences, and skills of the members of the organizations. The analysis of the hypothesis testing shows a positive and highly significant relationship between human capital and all dimensions of ACAP. Thus, the following hypotheses were accepted: H1a, H1b, H1c, and H1d. These results are consistent with the statements and studies presented by Daghfous (2004), Minbaeva et al. (2003), and Schimidt (2005) according to which individuals' skills, experiences, and creativity are the basis for the development of ACAP in the organizations.

However, despite the relatively balanced contribution of human capital to the four dimensions, there is greater influence on the capacity of transformation of knowledge. Individuals and the capital associated with them encourage the analysis of current standards, thus resulting in new ways of thinking. Hargadon and Sutton (1997) and Snell and Dean (1992) discussed the individuals' process of combining knowledge as the main source of new ideas in an organization. Therefore, human capital makes it possible to transform current knowledge by influencing the innovative capabilities of an organization (Subramaniam & Youndt, 2005).

In addition, a firm's capacity to recognize the value and access external knowledge depends on a sufficient number of qualified individuals (Cohen & Levinthal, 1990; Daghfous, 2004; Schimidt, 2005). Daghfous (2004) also stated that the diversity of experiences and knowledge increases the chance of new knowledge to be something related to the existing knowledge in the company, thus facilitating its assimilation. In addition, the individual members of the company add creativity to help the company create value from new knowledge (Daghfous, 2004; Lane et al., 2006).

As explained above, social capital is related to the mechanisms of social interactions within the firm. As expected, this capital positively influences the capacity of transformation of knowledge, confirming the hypothesis H1g. This result confirms the positive relationship found by Jansen et al. (2005), especially the density of connections between the members of the organization, including trust and cooperation, facilitating this capacity. Subramaniam and Youndt (2005) found a strong association of social capital with incremental and radical innovation. These authors highlighted the importance of social networks for unexpected and unusual combinations, transforming knowledge into innovations.

It has been also proven that social capital significantly influences the capacities of acquisition and assimilation of knowledge. However, on the contrary to the expected, the influence is negative. This negative result was hypothesized by Jansen et al. (2005). However, they failed to show this result. Crowded social networks may increase the redundancy of information and decrease access to divergent views because they may hinder individuals from conducting more extensive research (Nahapiet & Ghoshal, 1998), inhibiting the acquisition and assimilation of new external knowledge (Jansen et al., 2005). In addition, authors such as Ashforth and Saks (1996) pointed out that socialization tactics motivate individuals to respond to situations in a predictable manner, leading to deprivation of freedom and predictable interpretations, which may be the case of this study. Such findings are consistent with the results of our study. However, Fosfuri and Tribó (2008) conducted a study of Spanish companies of different industries and found that acquisition and assimilation are also positively influenced by these social mechanisms. It is likely that the difference between industries and organizational environments affect these relationships, since they are positive in some contexts and negative in others.

The influence of social capital on exploitation of knowledge could not be confirmed, contradicting the hypothesis H1h. This is in disagreement with the study by Jansen et al.

(2005), which found a positive relationship in European financial service companies. Again, this result suggests that the difference between industries and organizational environments affects the results.

Organizational capital is related to the tools and architecture provided by an organization with the purpose of retaining and transferring knowledge throughout its business activities, including organizational culture, values and attitudes, and organizational structure, considering the formal mechanisms for structuring the company. Evidence confirms the positive and highly significant relationship between organizational capital and all dimensions of ACAP. Thus, the following hypotheses were accepted: H1j, H1k and H1l; and this construct had a strong impact on capacities. This capital contributes more strongly to the acquisition and assimilation of knowledge, confirming the importance of formalizing these processes (Cohen & Levinthal, 1990; Daghfous, 2004; Schimidt, 2005; Van Den Bosch et al., 2003; Van Den Bosch et al., 1999). In addition, in a quite intense manner, organizational capital contributes to the transformation and exploitation of knowledge. These results are consistent with the studies by Jansen et al. (2005), Zander and Kogut (1995), and Zollo and Winter (2002).

Even with regard to the influence of ACAP on innovation, we confirmed a positive relationship of acquisition, transformation, and exploitation of knowledge. Thus, the following hypotheses were accepted: H2a, H2c, and H2d. These findings support the ideas of several authors (Cohen & Levinthal, 1990; McCann & Folta, 2008; Zahra & George, 2002), which were confirmed by the empirical studies by Fosfuri and Tribó (2008) and Tsai (2001).

However, the direct relationship between assimilation and product innovation (H2b) was rejected. Such evidence is not in agreement with the study by (Fosfuri & Tribó, 2008). It is worth mentioning that these authors did not separate acquisition from assimilation, which could change the results. Such difference in the results may also be caused by differences in the industries and organizational environments of the companies, as it has been shown in other constructs. As mentioned in our review of the literature, a group of authors have suggested that ACAP is also influenced by external factors, such as sources of knowledge and characteristics of the partners, competitive and regulatory environment, which in turn influences the organizational outcomes (Daghfous, 2004; Dyer & Singh, 1998; Lane et al., 2006; Lane & Lubatkin, 1998; Todorova & Durisin, 2007; Zahra & George, 2002).

Furthermore, this result may be related to the type of innovation surveyed, i.e. product. Some authors argue that the results of ACAP may vary, including not only products and services. Zahra and George (2002) considered that ACAP may lead to competitive advantage based on strategic flexibility and process innovation. Lane et al. (2006) argued that ACAP has a recursive effect, promoting organizational learning, expanding the knowledge base, and influencing the configuration of the firms' resources and strategies.

In addition, Todorova and Durisin (2007) argued that transformation of knowledge is not a consequence of assimilation; instead, it is an alternative process of assimilation, which may lead to different organizational results. According to these authors, when the new idea fits well into the existing cognitive schemes, it is only slightly modified to fit better. Thus, it is soon incorporated into the existing cognitive structures, only requiring "assimilation". Conversely, when new developments or ideas cannot be changed to fit into the existing knowledge structures, "transformation" is used. Kim (1998) also separated the capacity to assimilate external knowledge (mainly through a process of imitation) from the capacity to create new knowledge.

In terms of explained variance, ACAP is largely explained by the intellectual capital of the companies. Acquisition of knowledge has 83% of explained variance; assimilation of

knowledge has 86%, transformation of knowledge has 62%; and exploitation of knowledge has 53% of variance explained by different capitals. These percentages highlight the impact of intangible assets on the capacity to acquire and use external knowledge. It is also possible to confirm the importance of ACAP for product innovation, since almost 30% of the innovations can be attributed to this dynamic capability.

7 CONCLUSIONS

Intellectual capital has an influence on ACAP, but the elements that make up intellectual capital have different impact on the dimensions of ACAP. The capacities of acquisition, assimilation, and exploitation of knowledge are influenced in a more significant manner by organizational capital and human capital. Transformation of knowledge is influenced in a balanced manner by organizational capital and human capital, and in a more moderate manner by social capital. In turn, ACAP has an influence on innovation, with each dimension being influenced at different levels. Acquisition and exploitation of knowledge have a more intense influence, whereas transformation of knowledge has a more moderate influence. After these relationships are established, it is very likely that the probability of product innovation increases.

There is strong evidence that these constructs and relationships are influenced by the characteristics of the industries and organizational environments. In this sense, it is worth noting that there were few radical innovations developed by the companies included in our sample. This led to conclude that this order model of innovation focuses primarily on incremental innovation. It is possible that these relationships are different when considering only radical innovation. Studies such as those by Subramaniam and Youndt (2005) suggest this.

The study tried to contribute to a better understanding of the topics investigated, both in terms of academic knowledge and management practice. Specifically about intellectual capital, the study reinforces the influence of each of its elements for the competitiveness of firms, which is in agreement with previous studies (Delgado-Verde et al., 2011; Subramaniam & Youndt, 2005). Additionally, shows evidence that the industry and the competitive environment of the companies have an influence on the relevance of capitals, especially social capital. In terms of ACAP, the study contributes to the discussion of its concept and dimensions. It also contributes to the understanding of the internal factors necessary for the development of ACAP. In terms of innovation, this research shows important findings on the influence of intangible resources and capacity of absorbing external knowledge for the development of innovative products in the industrial sector. We showed which resources have an influence on the capacity to absorb and use knowledge, as well as how these capacities have an impact on product innovation.

Another type of theoretical contribution refers to the integration of these research topics, highlighting the innovative character of this study. We could find previous studies addressing the relationship between intellectual capital and innovation, however, we could not find any previous studies addressing the influence of intellectual capital on the dimensions of ACAP or the influence of the different dimensions of ACAP on innovation, building an analytical model that integrates all these constructs.

In addition, the validation of the constructs in a different context is a significant contribution, because it demonstrates the validity in an empirical manner. Furthermore, the

confirmation of the capacities of knowledge as four different constructs is an advance in the literature on ACAP.

Although our study achieved the proposed objectives and the methodological process was strictly conducted, our study has some limitations. The method used often determines the scope of the conclusions in a study. The first limitation of our study is related to data collection. The use of a Likert-type scale during data collection involves subjective answers. However, this method has been used in many studies related to intangible assets and knowledge because documents and organizational databases hardly capture such information. Furthermore, this type of research would be impossible using a large sample. Another limitation is related to the use of a single key informant per company. With the purpose of reducing this impact, we used selection criteria to choose the respondents and we ensured their confidentiality. However, the presence of bias cannot be completely excluded. Another limitation is the cross-sectional design because it shows only a partial picture of the reality at the time of measurement. Although our results are consistent, longitudinal studies should be conducted to confirm the causal claim of the model. The dynamic character of the competitive environment also can only be investigated in longitudinal studies. In addition, greater detail on these relationships can only be achieved through in-depth qualitative studies. These limitations may be used as suggestions for future studies.

In spite of the fact that we used the structural equation modeling, which is a confirmatory technique, most hypotheses were confirmed, and both the constructs and the model were validated, this study is exploratory to some extent. This is a first attempt to organize a number of factors simultaneously, seeking to explore their relationships. In this sense, we believe that new scales should be developed for these constructs, thus providing more elaborated measurement. In addition, we suggest the integration of other factors that have an influence on ACAP, such as tangible factors and variables of the external environment, providing a more complete model.

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