6

Inovação em pequenas e médias empresas: a influência da capacidade absortiva

Innovation in small and medium enterprises: the influence of absorptive capacity

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◼ RESUMO

Este estudo examinou a influência dos elementos que compõem as dimensões da capacidade de absorção (CA) na capacidade de inovação (CI) das pequenas e médias empresas (PMEs). A pesquisa ocorreu por meio de uma survey com aplicação de questionários a 309 PMEs. Para analisar os dados utilizamos a técnica de modelagem de equações estruturais (MEE). Os resultados mostraram que as dimensões de capacidade de absorção potencial (PACAP) e capacidade de absorção realizada (RACAP) possuem efeitos positivos, mas distintos, na CI das PMEs, contudo, o impacto na CI aumenta quando as dimensões da CA são avaliadas de forma multidimensional e individual. O estudo contribuiu teoricamente ao comprovar a multidimensionalidade do constructo da CA no universo de PMEs. Como contribuição gerencial evidencia-se que a RACAP possui maior influência sobre a CI das PMEs, o que comprova a importância de os gestores/proprietários desenvolverem rotinas que potencializem a transformação e aplicação do conhecimento.

Palavras-Chave: Capacidade de Inovação; Capacidade de absorção; Pequenas e Médias Empresas; Modelagem de Equações Estruturais.

◼ ABSTRACT

This study examined the influence of the elements that make up the absorptive capacity (AC) dimensions on the innovation capacity (IC) of small and medium enterprises (SMEs). The research took place through a survey with questionnaires applied to 309 SMEs. We used the structural equations modeling technique (SEM) to analyze the data. The results showed that the dimensions of potential absorptive capacity (PACAP) and realized absorptive capacity (RACAP) have positive but distinct effects on the IC of SMEs. However, the impact on IC increases when the dimensions of the AC are evaluated in a multidimensional and individual manner. The study contributed theoretically by proving the multidimensionality of the MC construct in the universe of SMEs. As a managerial contribution, it is evident that RMCAP has a greater influence on the IC of SMEs, which proves the importance of managers/owners developing routines that enhance knowledge transformation and application.

Key-words: Innovation Capacity; Absorptive Capacity; Small and medium-sized enterprises; Structural equations modeling.

1 INTRODUÇÃO

Innovation is directly related to the creation and updating of knowledge, requiring companies to generate new ideas and efficiency in their processes, continuously adapting their organizational practices (VARGAS; GONÇALO; RIBEIRETE; SOUZA, 2017). In recent years, it has been shown that absorptive capacity (AC) is essential to support organizational innovation (LANE; Koka; PATHAK, 2006; Gebauer; WORCH; TRUFFER, 2012).

Companies exposed to the same amount of external knowledge can benefit at different levels depending on the degree of absorptive capacity (THOMAS; WOOD, 2014). Thus, AC can determine the degree of openness of an enterprise, configuring as one of the essential factors that provide competitive advantage in the same sector (DEEPAK; SUBRAH-MANYA, 2017).

Small and medium enterprises (SMEs), which have limited financial resources, must acquire external knowledge through exchanges between companies and optimize their organizational learning processes to utilize this knowledge and achieve business sustainability (KOTABE; JIANG; MURRAY, 2011; ELSETOUHI; ELBELTAGI, 2013). These companies face continuous change and must balance their decisions between a look to the present and another to the future. Thus, an orientation towards innovation becomes fundamental (MÜLLER; BULIGA; VOIGT, 2021). Our proposal is that the key for SMEs to create strategic innovation mechanisms is initially based on the development of higher levels of absorptive capacities (TALEBI; TAJEDDIN, 2011; BARBAROUX, 2014; AOKI; BADALOTTI, 2014).

Some studies (DÁVILA; DURST; VARVAKIS, 2018; CASSOL; ZANESCO; MARTINS; MARIETTO, 2019; AL MAMUN; FAZAL; MOHIUDDIN; SU, 2019) recently observed the configuration of AC in developing economies, such as Brazil, in search of an understanding of the routines and practices capable of boosting the construction of new organizational capacities and enhancing innovation in SMEs. However, questions remain about how SMEs develop the ability to absorb and internalize external knowledge. This is at the expense of its structural features, such as limited financial resources, simple hierarchical structure, simplified organizational routines, and little access to the scientific community compared to large enterprises.

Thus, understanding whether the dimensions of PACAP and RACAP influence the innovation capacity of SMEs distinctly becomes a field to be explored (DÁVILA *et al.*, 2018; CASSOL; MARIETTO; TONIAL; WERLANG, 2021). Therefore, we seek to answer: What is the level of influence of the potential absorptive capacity (PACAP) and the realized absorptive capacity (RACAP) in the innovation of small and medium enterprises? This research has the objective of analyzing the influence of the potential and realized absorptive capacity on the innovation capacity in small and medium enterprises.

We conducted quantitative research with a cross-sectional cut-out based on the *survey method to answer the research question and meet the objective*. Structured questionnaires were applied to 309 managers (owners and/or managers) of small and medium enterprises of the trade and services sectors located in Santa Catarina. The answers were analyzed with the *Smart PLS Software* using the structural equations modeling technique to test the hypotheses proposed in the research.

The results showed that the stages that make up the dimensions of PACAP (H1) and RACAP (H2) have a positive effect on the innovation capacity of the surveyed SMEs. The lowest impact on innovation capacity was found among all AC stages when individually analyzing the stages of the PACAP dimension, more specifically the assimilation stage (H1b). We also verified that the application stage (H2b) of the RACAP dimension presented the greatest impact on the innovation capacity of the SMEs investigated, confirming the proposed by the AC literature.

The study contributed to the understanding of the configuration of absorptive capacity in small and medium enterprises and its influence on innovation capacity. Furthermore, the present study analyzed AC from its multidimensionality and its relations with innovation capacity. In doing so, it was possible to verify the routines present in the investigated SMEs that can influence innovation, suggesting that the intra-organizational perspective can be as important to generate innovation results as the inter-organizational perspective.

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This article is organized by sections. Section 2 addresses the literature review on the research topic that supports the hypotheses of the study. The methodology adopted is presented in Section 3. Section 4 presents the results, which are discussed in Section 5 along with the research conclusions.

2 THEORETICAL SUPPORT OF THE HYPOTHESES

Several recent studies (LANE *et al.*, 2006; MUROVEC; PRODAN, 2009; LEE; WU, 2010; FLATTEN; GREVE; BRETTEL, 2011; CEPEDA-CARRION; CEGARRA-NAVARRO; JIMÉNEZ-JIMÉNEZ, 2012; JEON, HONG; OHM; YANG, 2015; CASSOL; GONÇALO; RUAS, 2016; CHICHKANOV, 2020) highlighted the importance of the relationship between absorptive capacity (AC) and innovation capacity (IC). However, few studies have concentrated efforts on understanding the processes and practices that characterize the absorptive capacity in a multidimensional manner (CHICHKANOV, 2020; CASSOL *et al.*, 2021) and its influence on innovation capacity in SMEs.

We consider by absorptive capacity the range of skills necessary to modify the implicit or tacit components of the knowledge acquired to meet local needs (MIGUELEZ; MORENO, 2015). The dimensions of absorptive capacity can be classified into two components: 1) potential absorptive capacity (PACAP), which considers acquisition and assimilation, and 2) realized absorptive capacity (RACAP), which is responsible for transformation and exploitation (NOBLET; SIMON; PARENT, 2011). With this research, we seek to verify the influence of the dimensions of PACAP and RACAP on the innovation capacity in SMEs.

2.1 Potential Absorptive Capacity (PACAP) and its influence on innovation

Potential absorptive capacity affects competitive advantage through management flexibility and resource and capacity development (CAMISÓN; FORÉS, 2010). PACAP consists of the processes of acquiring knowledge external to the company and its assimilation. Cooperation focused on generating

innovations is directly linked to the dimension of PACAP since it comprises activities with different types of partners, such as suppliers, customers, competitors, consultants, or universities (MUROVEC; PRODAN, 2009). PACAP allows a company to identify and assimilate the external knowledge flows necessary for its innovation process. Thus, PACAP constitutes the bridge, or gate, between what is outside and what is inside the company (ESCRIBANO; FOSFURI; TRIBÓ, 2009).

The ability to exploit external knowledge becomes a critical component of innovative capacities (PENNINGS; HARIANTO, 1992) since innovation is a complex activity in which new knowledge is applied for commercial purposes and part of this knowledge reaches the company through external sources (CASSIMAN; VEUGELERS, 2002). Many studies postulate that the ability to exploit external knowledge effectively is a critical factor for companies interested in improving innovation outcomes (VAN DEN BOSCH; VAN WIJK; VOLBERDA, 2003; LANE *et al.* 2006; LEAL-RODRÍGUEZ; ARIZA-MONTES; ROLDÁN; LEAL-MILLÁN, 2014; MIROSHNYCHENKO; STROBL; MATZLER; DE MASSIS, 2021). Additionally, the study developed by Cepeda-Carrión *et al.* (2012) bring empirical evidence that PACAP is an antecedent of RACAP and that the latter drives innovation. Corroborating, Limaj and Bernroider (2019) argued that the development of PACAP alone is not enough to promote innovations, and the development of mechanisms that promote RACAP is fundamental. Despite this, we sought to test whether the PACAP, composed of the acquisition and assimilation stages, could also generate innovations and thus propose the first hypothesis of the research:

H1: The potential absorptive capacity (PACAP) influences innovation capacity.

The first stage that composes PACAP is the acquisition of knowledge, to which ability of the company to locate, identify, value and acquire external knowledge is intrinsic (COHEN; LEVINTHAL, 1990; ZAHRA; GEORGE, 2002). Sources of external knowledge can be characterized through research and development or acquisition of technologies (TIGRE, 2006) and relationships with suppliers

(PORTER; HEPPELMANN, 2015) and customers (CEPEDA-CARRION; MARTELO-LANDROGUEZ; LEAL-RODRÍGUEZ; LEAL-MILLÁN, 2017). Furthermore, the development of diversified relationship and partnership networks can enhance access to information and facilitate access when necessary (DEZI *et al.*, 2019). At the same time, a greater organizational ability to acquire and use new information leads to a greater ability to launch innovations, given that new knowledge expands the breadth and depth of the previous knowledge base (HU, 2014; PATTERSON; AMBROSINI, 2015). The second hypothesis of the research assumes:

H1a: The capacity to acquire knowledge influences the innovation capacity.

Over time, PACAP becomes complex for companies since it is essential to search for new sources of knowledge, given that acquisition is a prerequisite for assimilation (BRETTEL; GREVE; FLATTEN, 2011). The capacity for assimilation refers to the processes and routines that allow the new information or knowledge acquired to be analyzed, processed, interpreted, understood, internalized, and classified (LANE *et al.*, 2006; NIGHTGOWN; FÓRES, 2010). The assimilation of knowledge represents its integration into organizational structures. Assimilative learning processes involve internal discussions and obtaining a shared interpretation of the new knowledge, as well as its incorporation into the knowledge base of the enterprise (GEBAUER *et al.*, 2012).

This second stage of PACAP, assimilation, consists of the interpretation and understanding of the knowledge of individuals. This stage is closer to the individual level than to the collective one. Thus, the higher the level of education and training of employees, the greater their individual capacity to assimilate and use new knowledge (MINBAEVA; PEDERSEN; BJÖRKMAN; FEY; PARK, 2003). The diversity of individual experiences and knowledge also increases the chance of new knowledge being added to existing ones in the company, facilitating its assimilation (DAGHFOUS, 2004). In particular, knowledge assimilation describes the capacity to understand new external knowledge and link it to the previous knowledge base (ALBORT-MORANT; HENSELER;

CEPEDA-CARRIÓN; LEAL-RODRÍGUEZ, 2018). For companies to be able to promote the generation of innovations, it is necessary that organizational knowledge is shared and enhanced through a dynamic process (IRELAND; HOSKISSON; HITT, 2008; FLATTEN *et al.*, 2011; DUARTE; CASTRO; BORGES, 2018). However, Engelman, Fracasso, Schmidt, and Zen (2017), and Enkel, Heil, Hengstler, and Wirth (2017) identified in their studies that the assimilation of knowledge has a low relationship with innovation. So we seek to understand in the third hypothesis if:

H1b: The capacity to assimilate knowledge influences the innovation capacity.

The second dimension of the AC comprises the stages of transformation and exploitation and configure the dimension of the realized absorptive capacity (RACAP). PACAP and RACAP are different concepts that involve distinct strategies and structures but must have connected processes. PACAP requires change, flexibility, and creativity, while RACAP requires control and stability (ALBORT-MORANT *et al.*, 2018).

2.2 Realized Absorptive Capacity (RACAP) and its influence on innovation

The realized absorptive capacity (RACAP) has an impact on the competitive advantage through the development of new products or processes (CAMISÓN; FORÉS, 2010). It is linked to the stages of transformation and exploitation of external knowledge that were previously acquired and assimilated by the company. Knowledge from external sources must be shared and enhanced in a dynamic process so that, among other results, it can lead to the generation of innovation (FLATTEN *et al.*, 2011; IRELAND *et al.*, 2008; MOUSTAGHFIR, 2008).

A company's capacity to acquire and assimilate new knowledge increases its knowledge base, while the ability to transform and exploit it allows the company to innovate. Thus, the realized absorptive capacity allows a company to innovate and create value (KHAN; LEW; MARINOVA, 2019). Although this conceptual understanding is widely accepted, empirical evidence is limited (MIROSHNYCHENKO *et al.*, 2021). Some studies have found that the realized

absorptive capacity is a antecedent of *exploitative* and *exploratory* innovation of product and process innovation (ALBORT-MORANT *et al.*, 2018), of new business creation and self-renewal (SUN; AN-DERSON, 2010). Thus, the fourth hypothesis seeks to understand:

H2: *The realized absorptive capacity (RACAP) influences the innovation capacity.*

If knowledge is not carefully stored and retained systemically, it cannot be quickly evaluated and used for future decision-making (MARTELO-LANDRO-GUEZ; CEGARRA-NAVARRO, 2014). If the acquired knowledge is not assimilated to be retained in the company's memory, it may be accidentally lost (AN-DREEVA; KIANTO, 2011), consequently, its transformation will not be possible.

Transformation capacity refers to the refine-ment of knowledge, externally acquired, to adapt it to internal routines to facilitate the transfer and combination of previous knowledge with new knowl-edge acquired and assimilated. The transformation of knowledge usually occurs through the coding of knowledge (MIROSHNYCHENKO *et al.*, 2021). The coding of knowledge is a "person-to-document" strategy that contributes to the storage, internal transfer, and diffusion of knowledge (BETTIOL; Di MARIA; GRANDINETTI, 2012). Coding increases the overall knowledge base and, once distributed and incorporated in the company, stimulates the absorp-tive capacity among the *stakeholders*. This, in turn, can lead to greater knowledge creation, innovations, and economic growth (COHENDET; EDWARD STEINMUELLER, 2000; MULLER; ZENKER, 2001).

The combination of internal knowledge with external knowledge, already assimilated and trans-formed, can foster innovation (LANE *et al.,* 2006; VAN WIJK; JANSEN; LYLES, 2008). Thus, the coding of knowledge seems to be beneficial for its transfor-mation and use by fostering the internal processes of knowledge development, thus contributing to innovation activities (MIROSHNYCHENKO *et al.*, 2021). From these discussions, the fifth hypothesis proposes to understand:

H2a: *The knowledge transformation capacity influenc-es innovation capacity.*

Finally, the application is related to the rou-tines, practices, and processes that create operations, knowledge, skills, services, or products (COHEN; LEVINTHAL, 1990; ZAHRA; GEORGE, 2002; LANE *et al.*, 2006; NIGHTGOWN; FÓRES, 2010). Therefore, a company's capacity to innovate can depend heavily on how well it can combine existing knowledge with new and apply it to "refine, extend, and leverage existing skills or create new ones by incorporating acquired and transformed knowledge into its operations" (ZAHRA; GEORGE, 2002, p. 190, our translation). Applying market knowledge can help companies identify new business oppor-tunities, including new product or service solutions required by the market. In this case, the application of knowledge helps to reduce market uncertainties, which increases the likelihood that the new product or service will be successful (CABIGIOSU; CAM-PAGNOLO, 2019). The application of knowledge can significantly increase the propensity for innovation and be applied not only to the development of inno-vative services but also to process innovations, such as new forms of delivery or commercialization of its services (CHICHKANOV, 2020). From these dis-cussions, the last hypothesis proposes to understand: **H2b The capacity to apply knowledge influences the innovation capacity.**

3 RESEARCH METHOD

This study conducted quantitative research, through a *survey* in small and medium enterprises (SMEs). This type of research aims to obtain data on the different characteristics, actions, or opinions of a target population (FREITAS; OLIVEIRA; SACCOL; MOSCAROLA, 2000) to validate the hypotheses proposed. The research is characterized as a cross-sec-tional cut since the data collection was carried out in a single moment, describing and analyzing the variables in that context.

3.1 Research Instrument

We used a multidimensional scale for AC in small and medium Brazilian enterprises developed and validated in the Tenconi study (2015) to investigate absorptive capacity (PACAP and RACAP). The scale was based on the configuration assumptions proposed by Zahra and George (2002) and was developed from the literature review and the scales proposed by Lichtenthaler (2009), Camisón and Forés (2010), Flatten *et al.* (2011), and Kotabe, Jiang and Murray (2011). Tenconi (2015) conducted interviews with academic experts and managers to develop the scale and, subsequently, validated the scale with exploratory and confirmatory factor analysis techniques in a sample consisting of 309 Brazilian SMEs

in the trade and services sector. The final scale was composed of sixteen variables, seven in the PACAP dimension and nine variables in the RACAP dimension, as shown in Chart 1.

We investigate innovation capacity as a dependent variable. The scale consists of eight items, four in the management innovation dimension and four in service innovation. The scale is original from the study conducted by Liao, Fei, and Chen (2007) and was adapted to the Brazilian context by Escobar (2012) in a survey of 213 small and medium service companies (Tourism and travel agencies), according to chart 2.

The research instrument underwent an adaptation of nomenclatures and drafting adjustments after the pre-test was performed on a sample of 20 managers

Chart 1 Absorptive capacity scale

Dimension	Construct	Variables	Code
PACAP	Acquisition	Our company expects employees to handle information beyond our activity sector	Aq1
		Accessing external sources to obtain relevant information is a common and very important activity in our company	Aq2
		Our company values and seeks information beyond our activity sector	Aq3
		Our company is oriented to continuously monitor trends and discover opportunities to be actively exploited	Aq4
	Assimilation	Our company has is a rapid flow of information, for example, if an area or department obtains important information, it promptly communicates this information to all other areas or departments	As1
		We hold periodic meetings between all areas of the company for the exchange of ideas, problems, new developments, and achievements	As2
		We have the ability to store relevant information obtained for future use	As3
RACAP	Transformation	Our employees can structure and use the knowledge they acquire	Tr1
		Our employees are used to absorbing new knowledge, preparing it for new purposes, and making it available to the company	Tr2
		Our employees can relate existing knowledge to new ideas	Tr3
		Our employees can apply new knowledge in their practical work	Tr4
		We are adept at reactivating existing knowledge for new uses	Tr5
		We quickly recognize the usefulness of new knowledge with existing knowledge in the company.	Tr6
	Application	Our company regularly reconsiders technologies and adapts them according to new knowledge	Ap1
		Our company can work more effectively by using new technologies	Ap2
		Our company can use and explore new knowledge to respond quickly to market changes	Ap3

Source: Tenconi (2015)

Chart 2 Innovation capacity scale

Dimension	Variables	Code
Management Innovation	The managers of the company have strategic participation or are fully engaged in the definition of strategies	I1
	The management of the company has a good understanding about the details of business operations	I2
	The company has a system of personnel incentives and well-being	I3
	The company has a constant search for new forms in which one can balance the activities in different areas of the business	I4
Service innovation	The company has product or service innovation, that is, any kind of improvement is introduced in products, services, or processes, without change in the physical structure of the company	I5
	The company can develop new products or services that are not offered by competitors	I6
	The company has a commercial differentiation, that is, the ability to differentiate the types of products or services compared to competitors	I7
	The company has diversified knowledge of the product or service, that is, the ability to develop applied knowledge for the creation of a diversified portfolio of product/service.	I8

Source: Escobar (2012)

(owners and/or managers) of small and medium enterprises. The applied instrument has multiple choice questions and uses a *Likert* scale of 7 points. The *Likert* scale was chosen because it is widely used as an instrument for measuring opinions, beliefs, or attitudes. The *Likert* scale has become very popular among researchers due to its reliability, ease of construction, and good information regarding the degree of feeling of the respondents (DALMORO; VIEIRA, 2013).

3.2 Population and sample

The universe of this study comprises the small and medium enterprises of the trade and service sectors located in Santa Catarina. The definition of small and medium enterprises, according to the complementary Law nº 123 of 2006, assigns microenterprises or small companies to the meaning of company, general partnership, limited-liability proprietorship, and entrepreneurs duly registered in the Registry of Commercial Companies or Civil Registry of Legal Entities.

Most academic research uses the quantitative criterion for evaluating SMEs, which avoids difficulties regarding evaluations and comparisons between studies. One of the quantitative criteria for measuring SMEs is gross income (turnover) or the number of employees (LEONE, 1991). In this research, we chose to use the number of employees to classify companies, as proposed by the Micro and Small Companies Support Service (SEBRAE). The sample was composed of trade and services SMEs with up to 99 employees as described in Table 1.

The tertiary sector is the fastest growing sector in the world, accounting for 65.8% of the national Gross Domestic Product (GDP) in Brazil in 2006. This

Table 1 Definition of size of establishments according to the number of employees

Size	Trade and services	Industry
Microenterprise (ME)	Up to nine employees	Up to 19 employees
Small enterprise (EPP)	From ten to 49 employees	From 20 to 99 employees
Medium enterprise	From 50 to 99 employees	From 100 to 499 employees
Large enterprise	100 or more employees	500 or more employees

Source: Sebrae Dieese (2013)

sector includes the trade (retail and wholesale) and service delivery sectors that include tourism, financial, legal, IT, communication, architecture, engineering, audit, consulting, advertising and advertising, insurance, brokerage, transport and warehousing, as well as public and private activities of Defense, Security, Health and education, among others (SEBRAE, 2010).

Santa Catarina has 276,285 active registered micro and small companies (according to data from DataSebrae, 2020), which generate more than 1,986 million jobs in the State, and 65% of Micro and Small Enterprises (MSEs) work in the trade or services sector. This research has as target population the small and medium enterprises of the trade and services sector, considering the representativeness of the sector in the Santa Catarina economy and the profile of the companies.

The sample was characterized as probabilistic since all individuals in the population have the same chance of being chosen, considering a representative sample of the population. We followed the guidelines of Hair Jr, Gabriel, and Patel (2014) to calculate the sample, using five to ten respondents per instrument variable. The research has 24 variables, requiring a minimum sample of 240 respondents. The initial sample was of 361 companies but 309 companies were validated. Fifty-two questionnaires were discarded because the companies were not considered SMEs (due to the number of employees declared) or belonged to the industry sector.

The questionnaires were sent by *email* to the Trade Associations of Santa Catarina (ACICs), which referred to the companies that were part of their database. We emphasize that the respondents identified themselves as owners and/or managers of the companies investigated.

3.3 Data analysis procedure

We used the Structures Equations Modeling (SEM) for data analysis through the *SmartPLS* 2.0 software. SEM allows us to analyze the relationship between multiple variables simultaneously, whether latent or observed (HAIR; BLACK; BABIN; ANDERSON; TATHAM; 2009), in addition to identifying the causal relationship between the variables.

As for the *SmartPLS* software, we relied on Hair *et al.* (2011), who explained that the program provides estimates and parameters that maximize the explained variance (R^2 values) of the studied models. Another justification for using the PLS method (*Partial Least Squares*) was the absence of assumptions about data distribution, such as normality or use of interval scales or large samples (MATEOS-APARICIO, 2011).

Initially, we performed the analysis of reliability, convergent validity, and discriminant validity of each variable. We first performed the tests verifying the direct relationship between PACAP (H1) and RACAP (H2) with innovation to investigate the hypotheses of the research. Subsequently, we performed the tests to measure the direct relationship between acquisition (H1a), assimilation (H1b), transformation (H2a), and application (H2b) with innovation.

4 DATA ANALYSIS AND RESULTS

When analyzing the respondent profile data, we observed (Table 2) that the owners and/or managers are largely women (53.7%) with complete higher education (50.2%), and over 36 years of age (54.8%).

The respondent company profile (Table 3) showed that most work in the trade sector (72.8%) and have up to nine employees (57.3%), being considered as microenterprises according to the Sebrae classification. The surveyed companies that have been active for more than six years in the market correspond to 66.7%.

This research used a two-phase approach to the evaluation as proposed by Hair *et al.* (2014): 1) evaluation of the measurement model and 2) model estimation and hypothesis testing to test the model and perform the hypothesis test.

4.1 Measurement Model

The first stage was assessing the measurement model, aiming to analyze the reliability and validity of the model. The criteria verified were: i) individual external loads of the variables (betas); ii) composite reliability; iii) convergent validity (AVE); and iv)

Table 2 Respondent profile

Variable	Attribute	Frequency	%
Gender	Male	143	46.3
	Female	166	53.7
Schooling	Incomplete Elementary Education	3	1.0
	Complete Elementary Education	15	4.9
	Incomplete High School	13	4.2
	Complete High School	71	23.0
	Incomplete Undergraduate Studies	52	16.8
	Complete Undergraduate Studies	103	33.3
	Incomplete Graduate Studies	7	2.3
	Complete Graduate Studies	45	14.6
Age group	Up to 25 years	39	12.6
	From 26 to 30 years	54	17.5
	From 31 to 35 years	47	15.2
	From 36 to 40 years	53	17.2
	From 41 to 45 years	58	18.8
	Over 46 years	58	18.8

Source: Research data (2019).

Table 3 Company profile

Sector of activity	Trade	225	72.8
	Services	84	27.2
Number of employees	Up to nine employees	177	57.3
	From ten to 49 employees	124	40.1
	From 50 to 99 employees	8	2.6
Time in activity	Between 1 and 2 years	34	11.0
	Between 3 and 5 years	69	22.3
	Between six and ten years	93	30.1
	Over 11 years	113	36.6
Family business	No	148	47.9
	Yes	161	52.1

Source: Research data (2019).

Table 4 Reliability analysis of the constructs

Constructs 2nd Order	Constructs 1st Order	N items	Cronbach's Alpha (CA)	Composite Reliability (CR)	Convergent Validity (AVE)
PACAP	Acquisition	04	0.764	0.850	0.586
	Assimilation	03	0.715	0.840	0.637
RACAP	Transformation	06	0.844	0.885	0.564
	Application	03	0.783	0.874	0.698
Innovation Capacity	Management Innovation	04	0.807	0.874	0.635
	Innovation Services	04	0.799	0.869	0.624

Source: Research data (2019).

Table 5 Pearson correlation and the square root of the AVE of the latent variables of the constructs

Dimensions	Application	Acquisition	Assimilation	Management Innovation	Innovation Services	Transformation
Application	**0.836**					
Acquisition	0.452	**0.766**				
Assimilation	0.369	0.528	**0.798**			
Management Innovation	0.542	0.544	0.502	**0.797**		
Innovation Services	0.541	0.483	0.420	0.634	**0.790**	
Transformation	0.518	0.455	0.517	0.571	0.516	**0.751**

Source: Research data (2019).

* The values in bold (diagonal) are the square root of the AVE and the other values are the correlations between the variables.

Table 6 Predictive Relevance Analysis (Q^2) and Effect Size (f^2) of the constructs

Constructs 2nd Order	Constructs 1st Order	CV RED (Q^2)	CV COM (f^2)
PACAP	Acquisition	0.452	0.315
	Assimilation	0.424	0.288
RACAP	Transformation	0.456	0.386
	Application	0.414	0.379
Innovation Capacity	Management Innovation	0.493	0.386
	Innovation Services	0.476	0.370

Source: Research data (2019).

discriminant validity (*Fornell-Larcker*), as shown in Table 4.

By analyzing the individual external loads of the variables (betas) we verified that the AVEs of the constructs PACAP (acquisition and assimilation) and RACAP (transformation and application) were superior to 0.5, as proposed by Hair *et al.* (2014), assuming that the model converges to a satisfactory result (FORNELL; LARCKER, 1981, HAIR Jr *et al.*, 2014) and it is not necessary to exclude variables from the model.

The reliability and convergent validity of the constructs were evaluated through the internal consistency of the constructs using *Cronbach' Alpha (CA)* and the composite Reliability (CC) of each construct. AC values between 0.60 and 0.70 were considered adequate in exploratory research. It is suggested that it is preferably greater than 0.70. CR values of 0.70 and 0.90 are considered satisfactory (HAIR *et al.,* 2014). We observed, according to the Table below, that the values of reliability and convergent validity of the model were adequate.

The discriminant validity analysis verified that the variables are not unduly related to indicators of distinct constructs (HAIR *et al.*, 2009). In this research, we used the *Fornell-Larcker* criterion to evaluate the validity since it aims to compare the Square Roots of the AVEs values of each construct with Pearson's correlations between the constructs (HENSELER; RINGLE; SINKOVICS, 2009; HAIR *et al.,* 2009). Discriminant validity indicates the extent to which latent variables are independent of each other (HAIR Jr *et al.*, 2014). According to Table 5, all the AVE values (highlighted) are superior to the

other correlations presented, which indicates a discriminant validity between the constructs.

4.2 Structural Model and Hypothesis Testing

Following the recommendations of Hair Jr *et al.* (2014), the structural model was evaluated in relation to structural relationships, in which we verified the predictive relevance (Q^2) or *Stone-Geisser* indicator that evaluates the accuracy of the adjusted model where values greater than zero should be the evaluation criterion (HAIR Jr *et al.*, 2014). The predictive relevance of the model is observed in Table 6 since all dimensions were greater than zero. Subsequently, we analyzed the size of the effect (f^2) or Cohen indicator, in which the value is obtained by including and excluding constructs from the model (one by one). Hair Jr *et al.* (2014) suggest that values between 0.02 and 0.15 are considered small effects, values between 0.15 and 0.35 are considered medium effects, and values above 0.35 are considered large effects. According to Table 6, the effects of the dimensions are considered to be large in the model as a whole.

Finally, the last test performed sought to verify the structural relationships evaluated using t-values and p-values. For Beta to be accepted, one must test the causal relationship between two constructs and verify whether the relationship is significant or not. Therefore, the Student t-test is used, where values above 1.96 are considered significant at 5% or 0.05, that is, the constructs are related (HAIR *et al.*, 2009). Thus, we performed the H1 and H2 hypothesis tests and verified the positive influence of the potential absorptive capacity (t = 5.355) and the realized

Table 7 Result of the path analysis and hypothesis testing

| Hypotheses	b	T-value	P-Value	Result
H1: PACAP - > Innovation Capacity	0.334	5.355	0.000	Confirmed
H1a: Acquisition - > Innovation Capacity	0.240	4.017	0.000	Confirmed
H1b: Assimilation- > Innovation Capacity	0.139	2.918	0.004	Confirmed
H2: RACAP - > Innovation Capacity	0.486	8.503	0.000	Confirmed
H2a: Transformation - > Innovation Capacity	0.261	4.786	0.000	Confirmed
H2b: Application - > Innovation Capacity	0.306	5.606	0.000	Confirmed

Source: Research data (2019).

Figure 1 Hypotheses H1 and H2 test
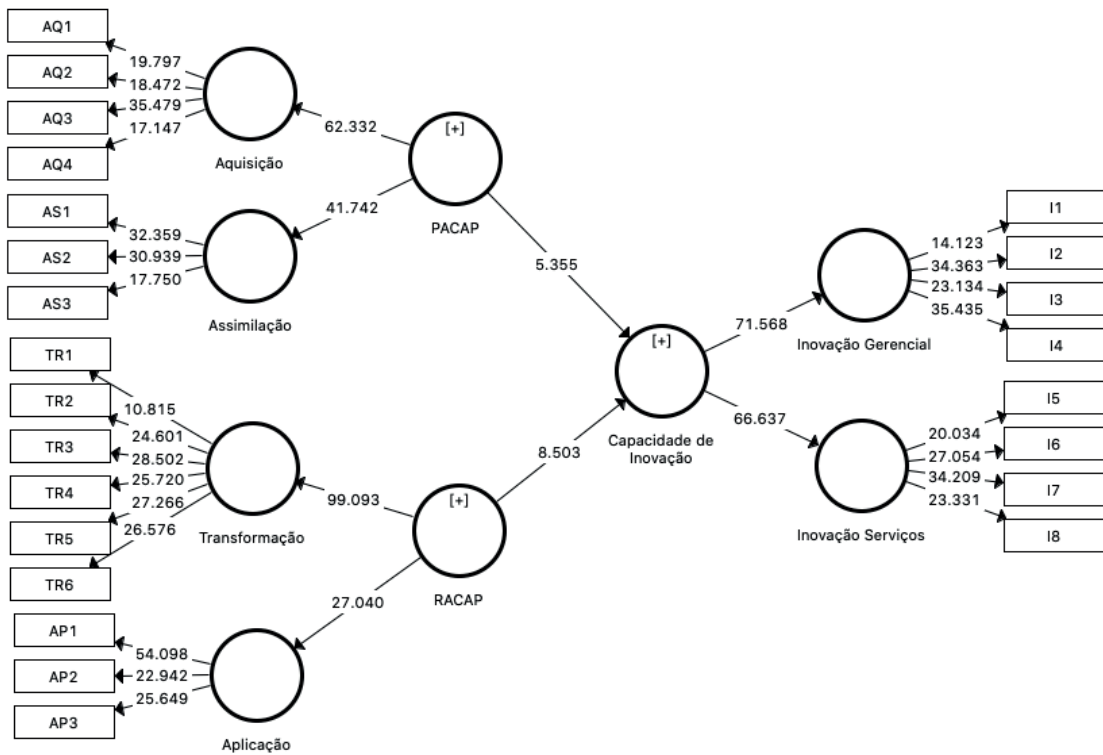
Source: Research data (2019).

Figure 2 Hypotheses H1a and H1b and H2a and H2b test
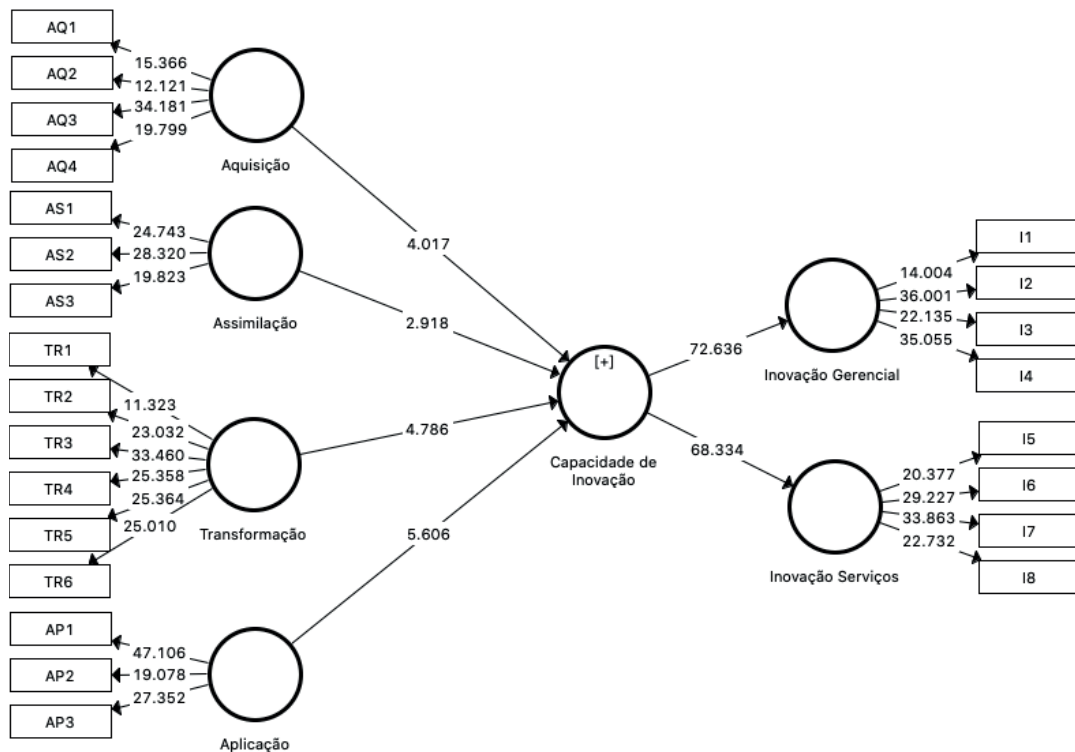
Source: Research data (2019).

absorptive capacity (t = 8.503) on the innovation capacity, as shown in Figure 1.

The hypotheses H1a, H1b, H2a, and H2b were verified through tests that analyzed the individual impact of each dimension of AC (acquisition, assimilation, transformation, and application) on the innovation capacity (Figure 2), where we verified the positive relationship between the dimensions in SMEs.

The structural model presented representative significance for the relationships proposed in the hypotheses of the research, thus confirming them. We verified how much one construct relates to another by analyzing the path coefficients. All constructs showed a positive relationship concerning the β values. The values range from –1.0 to +1.0. Values close to +1.0 indicate very strong positive relationship between two constructs and values close to -1.0 indicate negative or low relationship. Values close to zero indicate weak relationships (HAIR Jr *et al.*, 2014). Table 7 presents the aggregate of the results obtained during the analysis.

According to HAIR Jr *et al.* (2014), the hypotheses with significance level below 0.05 are considered supported for scientific research. The structural model presented representative significance for the relationships proposed in the research hypotheses, statistically confirming the relationship between them.

5 RESULT DISCUSSION AND CONCLUSIONS

Our results confirmed that the absorptive capacity, constituted by the dimensions of the potential absorptive capacity and realized absorptive capacity, have a positive effect on the innovation capacity of SMEs. The results also confirmed that the PACAP and RACAP stages (analyzed individually) positively influence the innovation capacity of SMEs, confirming all the hypotheses of the research. However, the model presented different impacts on innovation as we will discuss subsequently.

The analysis of the size of PACAP showed a lower relationship than RACAP in the environment of the surveyed SMEs. This behavior was expected, as proposed by the literature (MIROSHNYCHENKO *et al.*, 2021). In other words, the form in which external

knowledge is acquired and assimilated has a lower influence on innovation in relation to the form in which this knowledge is transformed and exploited in small and medium enterprises. This can be translated into the perspective that it is not enough for SMEs to have the capacity to acquire and assimilate external knowledge since its transformation and application have a greater influence on innovation.

The results of the analysis of the influence of the stages of potential absorptive capacity (acquisition and assimilation) on innovation demonstrate that knowledge acquisition has a greater effect on innovation than assimilation. The ability to acquire new external knowledge in SMEs is linked to their dependence on the level of previous knowledge (HU, 2014; PATTERSON; AMBROSINI, 2015). Thus, enterprises with higher knowledge stocks based on diversity of knowledge, experience, and culture are likely to make a better acquisition of external knowledge. The participation of SMEs with more than six years of activity predominated in this study. Therefore, we can infer that SMEs that are active in the market longer tend to have a larger stock of knowledge and a more solid network of relationships (DEZI *et al.*, 2019), facilitating the acquisition of new knowledge and influencing innovation.

The results of the assimilation capacity showed that this stage presented the weakest relationship with innovation compared to the other stages that make up the CA. Our results corroborate with the studies of Engelman *et al.* (2017) and Enkel *et al.* (2017), in which the authors observed that this stage of AC presents a greater difficulty of SMEs to mobilize innovation. In this study, the results of knowledge assimilation indicate that companies have difficulties in correlating (communicating) and/or socializing new knowledge among employees.

These findings may be related to the low level of education of employees and managers (MINBAEVA *et al.*, 2003). We observed that 39% of respondents have complete high school or incomplete undergraduate studies. If added to the 33% who have complete undergraduate studies, this represents 72% of the sample. This difficulty of socialization concerns the difficulty that employees of SMEs have in analyzing, interpreting, internalizing, and classifying new knowledge. The literature proposes that enterprises

with difficulties in assimilating knowledge tend to develop a weak absorptive capacity (SØRENSEN; STUART, 2000).

The individual analyses of the RACAP stages, transformation, and application of knowledge showed a greater influence on the innovation capacity of the SMEs surveyed. Our results indicated that SMEs should pay greater attention to the processes related to the transformation and application of new knowledge to innovate.

The results of the capacity for transformation, internalization, and coding of knowledge demonstrated that the SMEs surveyed have practices capable of structuring and using the knowledge they acquire. The coding of this knowledge occurs through structuring in documents and work processes, which contributes to the storage, internal transfer, and dissemination of knowledge, corroborating with previous studies (BETTIOL et al ., 2012; MIROSHNYCHENKO *et al.*, 2021). These practices allow employees to refine the knowledge acquired to adapt them to internal processes, facilitating the transfer and combination of knowledge.

In this research, the application stage presented the greatest influence on the innovation capacity of SMEs. Companies have demonstrated a good capacity to reconsider their processes and create new operations. This capacity to reorganize internal processes allows us to infer that the simplest structures of SMEs seem to be adequate and facilitate the development of CA. SMEs have a structure generally composed of a family management with few employees. This seems to facilitate the implementation of new processes and/or practices arising from new knowledge since they have already been socially accepted and shared by the social structure of the company.

5.1 Theoretical and Practical Implications

The study showed that the stages that make up the knowledge absorptive capacity initially proposed by Zahra and George (2002) may undergo changes when analyzing the environment of SMEs. We infer that SMEs propose a distinct configuration when analyzing the stages of knowledge absorption, in which the practices and routines linked to the acquisition, transformation, and application of knowledge is evident.

We observed that the capacity to acquire knowledge is anchored in the previous knowledge that the company and its managers have, and in the ability to recognize and filter the knowledge necessary for the company at that moment. The capacity to transform knowledge absorbs practices linked to assimilation and is directly related to the coding of knowledge and instant application based on the existing daily demands in the company. And the ability to apply knowledge is inherent in the use of new technologies and changes in products or services to meet market demands (customers).

The study also theoretically contributes by demonstrating that the PACAP and RACAP stages can also influence the innovation capacity of SMEs. However, it seems feasible that the realized absorptive capacity dimension has a greater influence on the ability to innovate than the potential absorptive capacity dimension. Analogous to the study conducted by Limaj and Bernroider (2019), our results also corroborate that PACAP alone is not enough to promote innovation since it presented the least impact on innovation processes in SMEs.

The practical implications show that managers and/or owners of SMEs must ensure adequate attention to the stages of RACAP (transformation and application) of new knowledge. This dimension seems to be fundamental and decisive for the success of innovations in SMEs. In other words, there will be no progress for the enterprise seeking new knowledge in the external environment if it cannot apply and/or implement them to its daily routines (intrafirm) under the perspective of innovating.

5.2 Limitations and Suggestions for Future Studies

The present study has some limitations that elucidate research gaps to be explored by future studies. First, the geographical context of the companies studied, all located in Santa Catarina, does not allow the data to be generalized to the entire field of AC and Innovation Studies in SMEs. Thus, the results cannot be transferred to other geographical or cultural contexts without additional studies with different samples.

Second, each company had a single respondent who evaluated the constructs involved in this research in a single time frame. Although the answers obtained in this study were presented under the perspective of the organizational context, individual bias may occur. Therefore, in future studies, we suggest that other participants of the companies be involved in the research. This can provide distinct results on the configuration of absorptive capacity in SMEs.

This research did not address the differences between the characteristics of the sectors of SMEs (trade and services), nor did it control the size of the enterprises, to verify that the forces of the company, and the medium in which it is inserted, have distinct influences on the configuration of the CA. We suggest that future studies observe the behavior of control variables, such as: i) sector of activity; ii) time of activity of the company; iii) number of employees; iv) level of education, and v) family characteristics. The analysis of these variables can provide understanding about the configuration of AC in small and medium enterprises.

Additionally, future studies can evaluate other aspects of AC in the SME universe, such as its background: (1) previous knowledge related to sources of knowledge, (2) social integration mechanisms, (3) triggers, (4) appropriability regimes, (5) power relations, and (6) *gatekeepers* (COHEN; LEVINTHAL, 1990). The proposed intention is to verify which are the practices and/or routines determining the development of absorptive capacity in SMEs.

Finally, we still note some conceptual/semantic *gaps* in the scales developed or adapted to the context of SMEs. This seems to be leading the studies to some misunderstandings regarding the configuration of AC in this universe of enterprises that have specificities that must be observed. Therefore, we suggest a review of the proposed scales for AC research in SMEs adapted to the Brazilian context.

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