

ARTICLE

Model for the Development of Absorptive Capacity in Incubated Companies

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ABSTRACT

This study proposed a model for the development of absorptive capacity in incubated business, and their impacts on the innovativeness and organizational performance of companies incubated in the Brazilian context. The research was carried through the application of a questionnaire with incubator managers of Brazilian companies, where 141 respondents participated. Additionally, in the data analysis, Structural Equation Modeling was used. The following were perceived as precursors to the use of knowledge: the knowledge of professionals and assistance in capturing knowledge. Through these relationships, Potential Absorptive Capacity had a strong relationship with Received Absorptive Capacity, which demonstrated an excellent relationship with innovativeness and organizational performance. These findings allow the development of incentive policies that lead to assertive incubated companies in Brazil, in addition to academically advancing the discussion on the combination of characteristics that are necessary and must be developed in incubated companies through the proposed model.

KEYWORDS:

Innovation; Absorptive capacity; Business incubator; Structural Equation Modeling.

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MODELO PARA O DESENVOLVIMENTO DA CAPACIDADE ABSORTIVA NAS EMPRESAS INCUBADAS

RESUMO

Este estudo teve como objetivo propor um modelo para o desenvolvimento da capacidade absorptiva em empresas incubadas e seus impactos para a inovatividade e o desempenho organizacional das empresas incubadas no contexto brasileiro. A pesquisa foi realizada aplicando um questionário com gestores das incubadoras de empresas brasileiras obtendo-se 141 respondentes. Para a análise dos dados, foi utilizada a Modelagem de Equações Estruturais (MEE). Além disso, foram percebidos como antecedentes da utilização do conhecimento: os conhecimentos dos profissionais e o auxílio para a captação dos conhecimentos. Com essas relações, a Capacidade Absortiva Potencial tem uma forte relação com a Capacidade Absortiva Realizada, que demonstrou uma excelente relação com a inovatividade e com o desempenho organizacional. Esses achados possibilitam o desenvolvimento de políticas de incentivo às empresas incubadas de caráter mais assertivo no Brasil além de avançar academicamente na discussão sobre a combinação de características que são necessárias e devem ser desenvolvidas nas empresas incubadas com a proposição do modelo.

PALAVRAS-CHAVES:

Inovação; Capacidade absorptiva; Incubadora de empresas; Modelagem de Equações Estruturais.

1. INTRODUCTION

Policies that incentivize the creation of business incubators are growing all over the world and, as they grow, they become important tools of economic and social promotion. As such, it is important to understand the effect they have on companies, as highlighted by Alpenidze et al. (2019). The study by Lai and Lin (2015) identified that incubated businesses recognize that the assistance provided by incubators increases the rate of survival and growth after the initial entrepreneurial phase. Brun (2019) stated that few studies focused on the development of those incubated in incubators, and many aimed at the conformation of incubators.

Business incubation programs are important in minimizing the challenges that start-up companies face, as business incubators provide the necessary support for the development of innovative business ideas into successful ventures. Among the support provided by incubators to enterprises are physical facilities, resources, and specialized services (Somsuk & Laosirihongthong, 2014). In order to strengthen the relationship between incubators and incubated companies, it is necessary to understand the advantages that incubators offer to those being incubated.

One of the goals of incubators is to establish strategic partnerships with various institutions, in order to provide incubated entrepreneurs with access to information and innovation, qualified professionals, and development of cooperative projects. Thus, incubators help them in their absorptive capacity; that is, in the search and application of external knowledge important for early ventures. The exploration of external knowledge, which is fundamental to capacity for innovation, was called Absorptive Capacity (ACAP) by researchers Cohen and Levinthal (1989). ACAP is the company's ability to create new knowledge with the acquisition of

external knowledge (Ramos & Zilber, 2015; Caloghirou et al., 2004). The most innovative companies establish relationships by exchanging experiences and knowledge with other economic actors external to them (Caloghirou et al., 2004).

Developing ACAP in companies that are starting their activities is a challenge for business incubators. Some entrepreneurs, when starting a new business, may not have the entrepreneurial characteristics to create an innovative business from their initial ideas (Fukugawa, 2018; Nair & Blomquist, 2019; Redondo & Camarero, 2019) or they are unaware of the market they operate in. It is important for incubators to link incubated companies with strategic partners for sharing and exchanging knowledge (Flechas Chaparro et al., 2021). Incubator managers must stimulate the acquisition of knowledge outside of their incubated companies (Vincent & Zakkariya, 2021). Incubators, by helping incubated companies to capture and use important external knowledge for the performance of innovative ventures, contribute to a country's economic development. Emerging countries must have more assertiveness in the practices of absorbing knowledge to more successfully take advantage of the incubated companies' insertion in competitive markets. According to Tidd and Bessant (2015), small and medium-sized companies connect with external sources of innovation, thus improving their innovative performance. Knowing that, as the same authors stated, innovation exerts a positive influence on the emerging economies advancement.

However, there are difficulties in this incubation process, such as the one presented in the research by Høvig et al. (2017), in which they emphasize there is a limited exchange of knowledge between incubated companies. Due to the importance of identifying the main services incubators must provide to their incubated companies that can help in the development of ACAP, this study proposes a model for ACAP development in incubated businesses. The proposed model will analyze the influence of ACAP's background in the incubated companies and the ACAP performance regarding innovation and performance of the incubated companies. As per the proposed goal, the following research question guides this study: what kinds of support must incubators offer their incubated companies for them to develop their own ACAP? Few insights on how organizations must develop and collect knowledge and transform them to their advantage have been identified in the literature (Marrucci et al., 2022).

As an academic and practical contribution, this study intends to identify what kinds of support will help in the development of ACAP in incubated companies. Since incubators must provide support to their incubated companies, so they can develop their own ACAP in order to become more innovative and with better organizational performance.

Regarding studies on absorptive capacity, Volberda et al. (2010) state that much has been written about absorptive capacity, but there is a need for studies that address the nature of ACAP, the relationship of prior knowledge and the interaction with intra-organizational and inter-organizational managerial background to increase knowledge about ACAP. According to the authors, intra-organizational background, innovativeness, and the accomplished absorptive capacity have been little researched in the ACAP literature. As for Minbaeva et al. (2014), a theoretical review of articles on the concept and development of ACAP pointed to the need for more theoretical and empirical models on the topic to be developed, and for more work to contextualize its concept and its development. Among the findings of this article, the authors stated that, so far, there is no understanding as to whether the absorptive capacity is the same in all organizations, and that research is needed to understand how different contextual factors affect the development of absorptive capacity. Therefore, studying ACAP from research in business incubators is important to developing its theory in diverse types of organizations.

2. BACKGROUND

2.1. ABSORPTIVE CAPACITY

4

After Cohen and Levinthal coined the term “absorptive capacity” (ACAP), research was carried out to investigate the relationship of ACAP with innovativeness and organizational performance. The study by Kulkarni (2015) investigated the influence of absorptive capacity on company performance. According to the authors, for small companies to compete with large companies, a high level of ACAP is necessary. The results of these authors’ studies followed the theory of entrepreneurship, in which the size of the company does not prevent it from dominating the market, even in dynamic environments, revealing that there is an attractiveness rate that smaller companies must overcome in order to survive and grow. Small businesses have the advantage of quickly adapting to ever-changing environments.

The study by Kim et al. (2014) confirmed that the performance of a micro or small business is directly influenced by ACAP, as it affects new product development, market performance, and financial performance. Investments in ACAP contribute to the best results of micro or small business. It is known that companies that are incubated in incubators are micro or small businesses; consequently, ACAP will improve the incubated companies’ results.

Regarding investments in ACAP, authors Lin and Chang (2015) stated that companies need to invest in ACAP in its early developmental phase, in order to recognize their survival needs. For the authors, companies improve their ACAPs not only by increasing efforts in P&D but by making P&D alliances with experienced scientists and adopting other measures that can help them in new technological developments.

A firm’s innovation activity depends on the firm’s ability to recognize, assimilate, and exploit external information (Cohen & Levinthal, 1989; Caloghirou et al., 2004). For Wang and Guo (2020), the search for external knowledge is essential for the performance of innovation. This company’s absorptive capacity can be influenced by the individuals’ absorptive capacity, which can also be increased by the type of knowledge that the individual possesses (Cohen & Levinthal, 1990).

Cohen and Levinthal (1990) affirm that, to explore the external knowledge that will be critical for innovativeness in companies, prior knowledge is needed in order to recognize the value of relevant information. For the authors, accumulated knowledge helps in the ability to introduce new knowledge into memory. What they called knowledge acquisition is the ability to remember and use it, and the ability to assimilate information and learn from it is greater when the learning object is related to what is already known.

The relationship between internal and external knowledge was explored in the research by Xia and Roper (2016). The authors emphasize the importance of linking internal and external knowledge for innovation. External knowledge has not necessarily contributed to the company’s growth, as it will only benefit it when associated with its internal resources, emphasizing the importance of ACAP. According to the authors, the ability to exploit knowledge is an important factor for innovation and superior company performance.

Researchers Zahra and George (2002) identified, in a study, that ACAP has four dimensions: acquisition, assimilation, transformation, and exploration. For researchers, acquisition and assimilation capacities are dimensions of potential capacity (PACAP) and transformation and exploitation capacities are dimensions of realized capacity (RACAP).

After Zahra and George indicated that ACAP has two components, PACAP and RACAP, research was carried out to analyze these two dimensions and their influence on organizational

performance and innovativeness. Leal-Rodríguez et al. (2014) stated that there is no direct relationship between PACAP and innovation. PACAP and RACAP have different but complementary roles. PACAP levels enhance RACAP, which can improve innovation. Only the acquisition and assimilation of knowledge does not impact innovation. PACAP's relationship with innovation will only be positive when RACAP levels are medium and high. According to Leal-Rodríguez et al. (2014), the ACAP dimensions are relational, and the combination of the two dimensions has a positive effect on the capacity for innovation.

According to a study by Ali et al. (2016), the acquisition, assimilation, and exploitation of ACAP positively and significantly influenced organizational innovation, consequently increasing its performance. The transformation of knowledge as a dimension of ACAP does not influence organizational innovation, according to the authors. That is, they concluded that three of the four dimensions are the main drivers of organizational innovation and increase company performance, and transformation alone does not have a significant effect. The result of the study by Ali and Park (2016) stated that PACAP and RACAP should occur in that sequence and that they influence organizational innovation. PACAP raises the level of RACAP performed, but PACAP and RACAP simultaneously in organizations can be an obstacle to organizational innovation.

As discussed in this topic, the exploration of external knowledge and its application in company processes results in more innovative companies. It is up to the incubators to help the incubated companies to capture this external knowledge and transform it into new internal knowledge, which will generate more innovative incubated companies with high organizational performance. Incubators must provide conditions to create innovative incubated companies, as this is the only way to achieve good performance after the incubation process and contribute to the country's economic development.

2.2. BUSINESS INCUBATORS

The entrepreneur, when starting a new business, may not have the entrepreneurial characteristics to create an innovative business from their initial ideas (Fukugawa, 2018; Nair & Blomquist, 2019; Redondo & Camarero, 2019). As business incubators have links with other organizational entities that are essential for sharing and exchanging knowledge, experiences, and contacts with other companies, and these networks benefit incubated companies in the acquisition and exploration of opportunities (Chandra et al., 2014; Rubin et al., 2015; Alpenidze et al., 2019). Incubators must link incubated companies with strategic partners (Alpenidze et al., 2019; Redondo & Camarero, 2019). For Alpenidze et al. (2019), the services they should offer to their incubated companies are: links with strategic partners, market research, access to a guarantee program, loan funds, and network activities.

Incubators are growing all over the world, and it is necessary to assess their performance by analyzing factors that lead to success or failure and how they grow over the years, as well as understanding the effect that incubators have on their incubated companies (Alpenidze et al., 2019). Incubated companies leave business incubators when they become independent and financially viable (Mas-Verdú et al., 2015).

Some studies were carried out to analyze the importance of incubators in the development of innovative companies, such as the one by Grebenkin and Ivanova (2012), which proved the importance of business incubators in universities hypothesis for the creation of innovative entrepreneurship. The authors looked at the Ural State University incubator for three years and concluded how important higher education institutions are in helping create new companies,

highlighting the role of business incubators in supporting innovative ventures. Business incubators encourage students and university employees to create companies. For the authors, incubators provide business support that accelerates the development of innovative ideas at an early stage, with the support of businesspeople and consultants, through the incubator's contact networks.

The support that incubators offer their incubated companies is access to networks. According to Eveleens et al. (2017), initially, business incubators only offered infrastructure to their incubated companies, then they started to provide individual business advice and are currently focused on facilitating networks, helping them to develop their own networks. It is through network incubation that incubated companies access various types of knowledge and develop important relationships in the initial phase of a company. This assertion is corroborated by researchers Alpenidze et al. (2019). Their data showed that having strong social and business networks, availability, and access to resources are critical success factors in the business incubation process.

These relationships can occur internally with other incubators (Brun, 2019; Redondo & Camarero, 2019), and externally, with business agents such as potential customers, suppliers, financial institutions, or consultants (Eveleens et al., 2017; Brun, 2019; Redondo & Camarero, 2019).

Analyzing this network support, the authors Soetanto and Jack (2013) identified that network support strengthens the relationship between innovation strategy and performance, that is, network contacts, such as professors and researchers, improve knowledge about the technology, and contacting suppliers provides information about the market and the business. They also found that marketing support moderates the relationship between growth strategy and performance.

Knowledge was also perceived as a vital factor for the development of the incubated company. Binsawad et al. (2019) concluded that the knowledge sharing process increases the performance of incubated companies, as companies improve the goals of organizations when they encourage their employees to share their knowledge.

In order to strengthen the relationship between the incubator and its incubated companies, it is necessary to understand whether the advantages they offer, such as access to networks, experienced professionals, assistance in capturing and applying strategic knowledge, improve their absorptive capacity, and whether they will revert to more innovative companies with good organizational performance. Brun (2019) stated that few studies focused on the development of those incubated companies in incubators, and many aimed at the conformation of incubators.

In Brazil, in 1987, the first business incubator appeared in the city of São Carlos (SP) (Dornelas, 2002). The business incubation process began in Brazil with the objective of transferring the knowledge generated in universities and productive centers to the productive sector, through technology-based companies created by the Support Program for Technological Parks, promoted by CNPQ.

In 2004, the Brazilian government instituted Law No. 10973, of December 2nd, 2004 (Law of Innovation), which provides incentives for innovation and scientific and technological research in the productive environment and authorized the incubation of companies within Science Institutes and Technology (ICTs), with academic institutions being the main sponsors of business incubators (Theodoraki et al., 2018). This law also made it possible to create favorable environments to expand the relationship between university and business, making researchers available to help private enterprises.

2.3. HYPOTHESES AND PROPOSED MODEL

The precursor of the two dimensions of ACAP were suggested by the study by Miranda et al. (2021), which are: interaction between companies, knowledge of professionals, the capture of knowledge, and use of knowledge.

Regarding the interaction between companies, company incubators house their incubated companies in the same physical space, which allows an interaction between these companies. The physical proximity between companies facilitates interaction and networks, generating collective learning (Chuang et al., 2016), in which companies must interact with other units to improve their learning and absorptive capacity.

- **H1a:** The interaction with different businesses in the incubator environment is a precursor to the PACAP of incubated companies.
- **H1b:** The interaction with different businesses in the incubator environment is a precursor to the RACAP of incubated companies.

As for the knowledge of professionals, incubators are important for start-up companies, as they have experienced professionals with knowledge. Start-up companies do not have past experiences to learn from, nor do they have accumulated knowledge, and learning from past experiences in P&D projects develops the ability to gain access to relevant external knowledge (Vicente-Oliva et al., 2016).

- **H2a:** The knowledge of the incubator's professionals is a precursor to the PACAP of the incubated companies.
- **H2b:** The knowledge of the incubator professionals is a precursor to the RACAP of the incubated companies.

The capture of knowledge as a precursor of ACAP is due to the importance of accessing external knowledge and becomes important for research and development (P&D) in companies. Absortive capacity improves P&D projects, and knowledge exploration is the key to improving this result (Vicente-Oliva et al., 2016).

- **H3a:** The help of the incubator to capture external knowledge is a precedent for the PACAP of incubated companies.
- **H3b:** The help of the incubator to capture external knowledge is a precedent for the RACAP of incubated companies.

Just accessing external knowledge, as stated by Xia and Roper (2016), will not guarantee the company's growth, as external knowledge will only benefit a company when associated with the company's internal resources, emphasizing the importance of RACAP. It will be up to the incubated companies to help their companies in the use of the external knowledge captured.

- **H4a:** The incubator's assistance in using external knowledge is a precursor of the PACAP of incubated companies.
- **H4b:** The incubator's assistance in using external knowledge is a precursor, of the RACAP of incubated companies.

ACAP, for Wang et al. (2018), is one of the precursors of innovativeness in companies. The authors justify this assertion by stating that companies will be more innovative when recognizing the value of external information, assimilating and applying it internally; that is, they generate innovations by absorbing external knowledge, as also stated by Scuotto et al. (2017). As well as, Wang et al. (2018) concluded that companies improve their performance by reformulating their operational capabilities by redefining and implementing changes based on external knowledge, and Scuotto et al. (2017) stated that organizational performance depends on the ability to exploit external knowledge.

- **H5a:** PACAP positively affects the innovativeness of incubated companies.
- **H5b:** RACAP positively affects the innovativeness of incubated companies.
- **H6a:** PACAP positively affects the organizational performance of incubated companies.
- **H6b:** RACAP positively affects the organizational performance of incubated companies.

Figure 1 shows the background of the absorptive capacity theoretical model of incubators and their relationship with incubated companies' innovativeness and organizational performance.

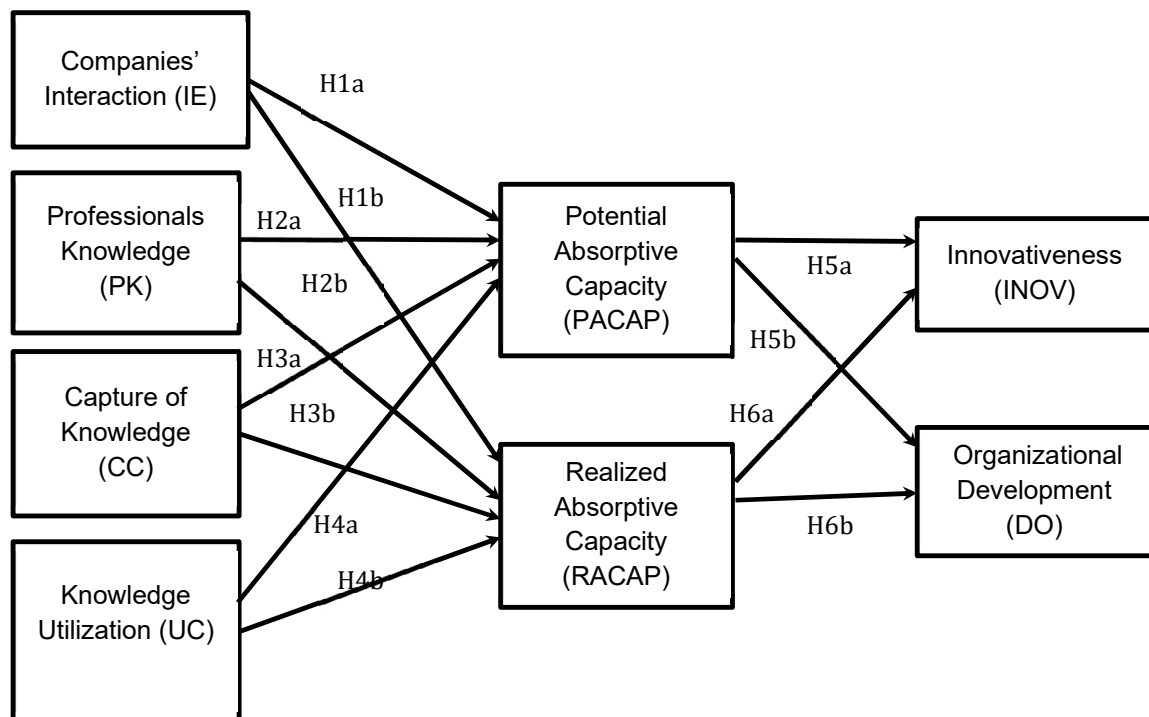


Figure 1. the background of ACAP theoretical model and its influence on innovativeness and the performance incubators.

Source: created by authors.

The theoretical model, shown in Figure 1, represents the relationships of the developed hypothesis in this paper. Through metanalysis, important factors were identified in the development of PACAP and RACAP within companies, and the influence these ACAP dimensions have in organizational performance. This study verifies how these factors work within the background of PACAP and RACAP, and the influence of these in the innovativeness and organizational performance of incubated companies.

3. METHOD

The approach applied in this study was quantitative. In the quantitative approach, there is the intention to guarantee the precision of the results and to avoid distortions in the analysis and interpretation, allowing, consequently, a safety margin regarding the inferences (Richardson et al., 1985). The variables were measured with data collection, proposing a descriptive study (Perovano, 2016).

The survey was carried out with incubator managers and their incubated companies. As part of the study, only incubators of companies located in Brazil, which have already received the certificate of The Reference Center for Support to New Ventures (Cerne), were researched. Cerne is a business incubator management model developed by the Brazilian Association of Science Park and Business Incubators (Anprotec) in partnership with the Brazilian Micro and Small Business Support Service (Sebrae), both Brazilian entities, with the aim of assisting incubators to generate innovative ventures, determined by good practices that must be adopted in their structures and services offered.

Until the month of September 2019, 42 Brazilian incubators were Cerne certified, and 421 incubated companies were linked to these incubators. The utilized method was based on probability sampling, where the population was known. We chose to research the certified incubators because we understand that they operate within the premises of the Cerne model, in which good practices are applied in the business incubation process, thus fostering innovative ventures with good performance, aiming to contribute to the country's economic development.

The number of incubators and managers of incubated companies that participated in the survey corresponded to 141 respondents. Therefore, the sample is characterized as non-probabilistic, for convenience (Hair et al., 2009). The applied questionnaire containing 36 observable variables was validated by Miranda et al. (2022). The questionnaire was sent online for the contacts obtained on the incubators' websites.

For data analysis, Structural Equation Modeling (SEM) was used, using the AMOS® software (v21). In agreement with Hair et al. (2009), the SEM explains the relationships between multiple variables. According to the author, they are equations that describe all the relationships between the constructs, considering the entire model. For Barrett (2007), the SEM fits a model to the same covariance matrix. The SEM was used in this study to adjust the model indicating the best relationships between the independent variables and the dependent variables. For Hair et al. (2009), the minimum recommended sample size to ensure stable maximum likelihood estimation (MLE) solutions are 100 to 150. Sharma et al. (2005) developed an article to analyze the effect of sample size, the number of indicators, factor loadings, and factor correlations to accept or reject models. For small samples, the authors propose index adjustments that are insensitive to the sample size for the overall fit of the model.

4. RESULTS

SEM was performed to fit the model to the data (Barrett, 2007). The Standardized Estimate (SE) values extracted from the output reports of the AMOS software analyze the relationships between the variables considering the entire model. SE values up to 0.3 are considered low, values between 0.3 and 0.5 as moderate, and above 0.5 as high intensity (De Guimarães et al., 2016).

According to the SE values of the initial integrated model, it indicated that the relationship between professionals' knowledge and PACAP and RACAP did not show statistical significance, with p values, respectively, 0.109 and 0.293. And, consequently, the SE values of the relationships were negative (- 0.117 and - 0.08), meaning that the knowledge of professionals from the incubators does not have statistical significance with the PACAP and RACAP.

The relationship of RACAP with innovativeness and organizational performance also had negative SE values (-1.347 and -1.442 respectively), demonstrating a weak relationship of RACAP with innovativeness and organizational performance, as shown in Figure 2.

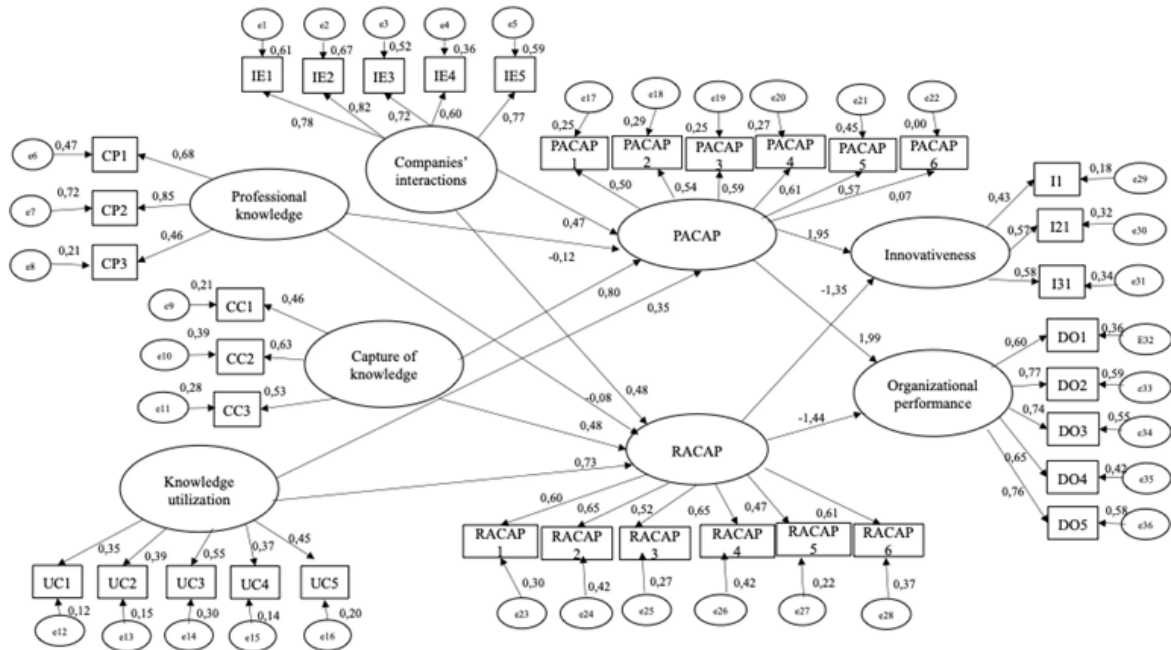


Figure 2. Initial integrated model
Source: Survey data (2020)

The other relationships were statistically significant, with $p < 0.005$, and showed SE values mostly above 0.5, indicating a high intensity. Some values between 0.3 and 0.5 were also observed, which indicates moderate intensity (see Table 1).

Table 1.
Estimate Standardized values and significance levels of relationships.

			Estimate Standardized	P
PACAP	<---	Interactions_Companies	0.468	***
RACAP	<---	Interactions_Companies	0.483	***
PACAP	<---	Knowlegde_Professionals	-0.117	0.109
RACAP	<---	Knowlegde_Professionals	-0.080	0.293
PACAP	<---	Capture_Knowlegde	0.802	***
RACAP	<---	Capture_Knowlegde	0.484	***
PACAP	<---	Utilization_Knowlegde	0.351	0.002
RACAP	<---	Utilization_Knowlegde	0.725	***
INOV	<---	RACAP	-1.347	0.002

Table 1.
Cont.

				Estimate Standardized	P
11	DO	<---	RACAP	-1.442	***
	INOV	<---	PACAP	1.949	***
	DO	<---	PACAP	1.992	***
	IE1	<---	Interactions_Companies	0.781	
	IE2	<---	Interactions_Companies	0.821	***
	IE3	<---	Interactions_Companies	0.721	***
	IE4	<---	Interactions_Companies	0.603	***
	IE5	<---	Interactions_Companies	0.769	***
	CP5	<---	Knowlegde_Professionals	0.457	
	CP3	<---	Knowlegde_Professionals	0.848	***
	CP1	<---	Knowlegde_Professionals	0.684	***
	CC1	<---	Capture_Knowlegde	0.463	
	CC2	<---	Capture_Knowlegde	0.625	***
	CC3	<---	Capture_Knowlegde	0.528	***
	UC5	<---	Utilization_Knowlegde	0.453	
	UC4	<---	Utilization_Knowlegde	0.373	0.001
	UC3	<---	Utilization_Knowlegde	0.550	***
	UC2	<---	Utilization_Knowlegde	0.391	***
	UC1	<---	Utilization_Knowlegde	0.347	0.002
	PACAP1	<---	PACAP	0.501	
	PACAP2	<---	PACAP	0.521	***
	PACAP3	<---	PACAP	0.612	***
	PACAP4	<---	PACAP	0.584	***
	PACAP5	<---	PACAP	0.652	***
	RACAP6	<---	RACAP	0.605	
	RACAP5	<---	RACAP	0.474	***
	RACAP4	<---	RACAP	0.649	***
	RACAP3	<---	RACAP	0.517	***
	RACAP2	<---	RACAP	0.649	***
	RACAP1	<---	RACAP	0.599	***
	INOV1	<---	INOV	0.426	
	INOV4	<---	INOV	0.569	***
	INOV5	<---	INOV	0.580	***
	DO1	<---	DO	0.602	
	DO2	<---	DO	0.771	***
	DO3	<---	DO	0.741	***
	DO4	<---	DO	0.650	***
	DO5	<---	DO	0.759	***

Source: Survey data (2020)

To test the best model, the AMOS software was used. Considering the weak relationship of professionals' knowledge indication in PACAP and RACAP in the previous tests, it was realized that the knowledge of professionals should not be related to the dimensions of ACAP, that is, in incubated companies, the knowledge of professionals from incubators does not behave as a precursor of PACAP and RACAP. But, as several studies have demonstrated, the importance of the existing knowledge base for the acquisition and exploitation of external knowledge (Larrañeta et al., 2017; Yoo et al., 2016; Vicente-Oliva et al., 2015; Debrulle et al., 2014), some attempts were made to verify which is the best relationship that will indicate a good use of this knowledge to improve PACAP and RACAP in incubated companies.

The adjusted integrated model places the professionals' knowledge as having a strong impact on knowledge capture (SE=1.0) and, consequently, this capture impacts, also strongly, on the use of knowledge (SE=1.0). And the use of knowledge showed a strong relationship with the PACAP (SE=0.91). The other relationships of the model showed very high intensity with SE=1.0 and the interaction between companies was only a precursor of the PACAP, being a moderate-intensity relationship with SE=0.418. The strong influence of the PACAP-RACAP relationship confirmed the finding of the Miroshnychenko et al. (2021) study, that PACAP directly influences RACAP, and this relationship sequence will influence innovativeness.

All relationships in this adjusted model were statistically significant with $p < 0.05$, except for the PACAP's relationship with the observable variable PACAP 6 ("merely acquiring and assimilating external knowledge does not improve the performance of the incubated company"), which $p = 0.432$. It was decided to remove this variable (PACAP 6) from the questionnaire.

The model with the exclusion of PACAP 6 is shown in Figure 3. It is observed that the SE values of the relationships remained the same with the removal of PACAP.

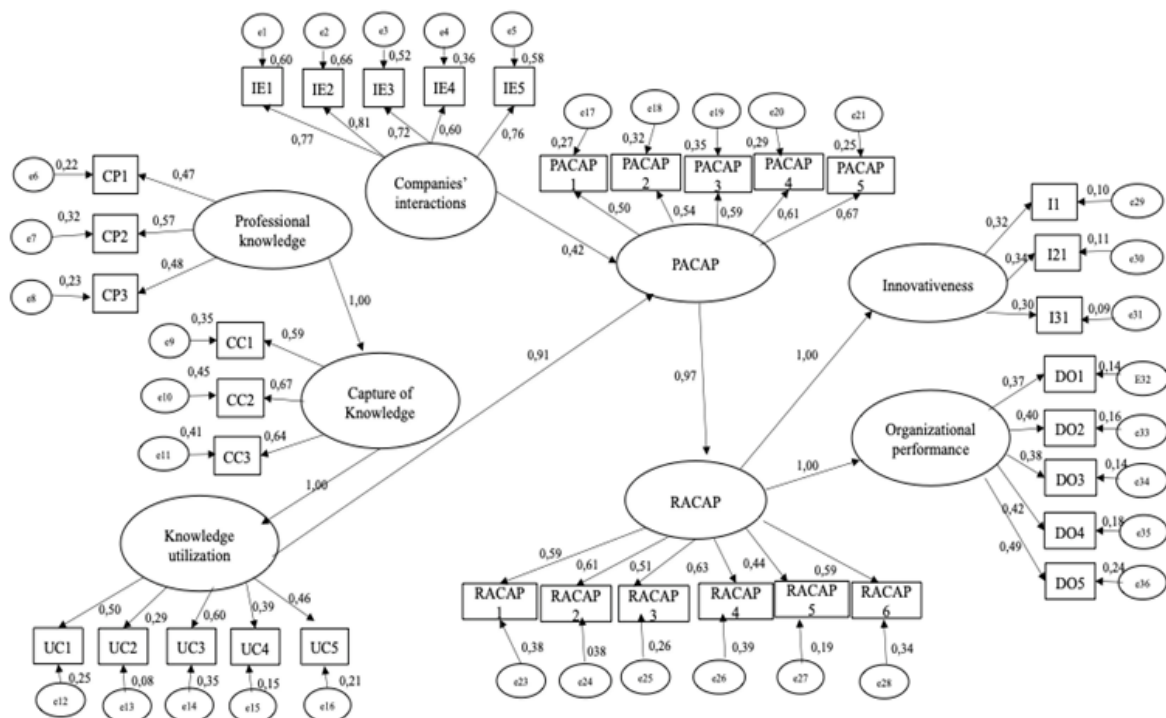


Figure 3. Final integrated model.

Source: Survey data (2020)

To analyze the correlation between the variables in the final model, the Pearson Correlation was verified, identifying that none of the correlations was above 0.7. All relationships remained statistically significant with $p < 0.05$ (see Table 2). The lowest SE value of the relationships is in the knowledge utilization construct (UC) in the observable variable UC 2 (“External knowledge will only benefit an incubated company when associated with the internal resources of these incubated companies”), demonstrating a low-intensity relationship with $SE = 0.287$.

Table 2.

Estimated Standardized values and significance levels of relationships.

			Estimate Standardized	P
Capture_Knowlegde	<---	Knowlegde_Professionals	1.000	***
Utilization_Knowlegde	<---	Capture_Knowlegde	1.000	***
PACAP	<---	Utilization_Knowlegde	0.909	***
PACAP	<---	Interactions_Companies	0.417	***
RACAP	<---	PACAP	1.000	***
I	<---	RACAP	1.000	***
DO	<---	RACAP	1.000	***
IE1	<---	Interactions_Companies	0.773	
IE2	<---	Interactions_Companies	0.811	***
IE3	<---	Interactions_Companies	0.723	***
IE4	<---	Interactions_Companies	0.603	***
IE5	<---	Interactions_Companies	0.759	***
CP5	<---	Knowlegde_Professionals	0.478	
CP3	<---	Knowlegde_Professionals	0.566	***
CP1	<---	Knowlegde_Professionals	0.472	***
CC1	<---	Capture_Knowlegde	0.593	
CC2	<---	Capture_Knowlegde	0.673	***
CC3	<---	Capture_Knowlegde	0.641	***
UC5	<---	Utilization_Knowlegde	0.457	
UC4	<---	Utilization_Knowlegde	0.386	***
UC3	<---	Utilization_Knowlegde	0.596	***
UC2	<---	Utilization_Knowlegde	0.287	0.004
UC1	<---	Utilization_Knowlegde	0.501	***
PACAP1	<---	PACAP	0.503	
PACAP2	<---	PACAP	0.535	***
PACAP3	<---	PACAP	0.593	***
PACAP4	<---	PACAP	0.608	***
PACAP5	<---	PACAP	0.674	***
RACAP6	<---	RACAP	0.587	
RACAP5	<---	RACAP	0.435	***
RACAP4	<---	RACAP	0.626	***
RACAP3	<---	RACAP	0.514	***
RACAP2	<---	RACAP	0.613	***
RACAP1	<---	RACAP	0.593	***

Table 2.
Cont.

				Estimate Standardized	P
INOV1	<---	INOV		0.319	
INOV4	<---	INOV		0.338	0.005
INOV5	<---	INOV		0.301	0.009
DO1	<---	DO		0.369	
DO2	<---	DO		0.405	***
DO3	<---	DO		0.381	0.001
DO4	<---	DO		0.423	***
DO5	<---	DO		0.494	***

Source: Survey data (2020)

The final integrated model showed the best relationships (according to Table 3) and indicated significant improvements in the SE values compared to the initial integrated model.

Table 3.

Hypothesis tests (covariance and correlations) - initial integrated model and final integrated model.

Hypotheses	Constructs	Initial Integrated Model		Final Integrated Model	
		SE	UE	SE	UE
H1	Interactions_Companies → PACAP	0.468	0.470	0.417	0.418
H2	Interactions_Companies → RACAP	0.483	0.484		
H3	Knowlegde_Professionals → PACAP	-0.117	-0.116		
H4	Knowlegde_Professionals → RACAP	-0.008	-0.080		
H5	Capture_Knowlegde → PACAP	0.802	0.799		
H6	Capture_Knowlegde → RACAP	0.484	0.485		
H7	Utilization_Knowlegde → PACAP	0.351	0.356	0.909	0.909
H8	Utilization_Knowlegde → RACAP	0.725	0.724		
H9	PACAP → Innovation	1.949	1.974		
H10	PACAP → Organizational_performance	1.992	2.017		
H11	RACAP → Innovation	-1.347	-1.375	1.000	1.000
H12	RACAP → Organizational_performance	-1.442	-1.471	1.000	1.000
	Knowlegde_Professionals → Capture_Knowlegde			1.000	1.000
	Capture_Knowlegde → Utilization_Knowlegde			1.000	1.000
	PACAP → RACAP			1.000	1.000

Source: Adapted from Severo, De Guimarães and Dorion (2018).

Table 4 shows the fit indices of the initial model and the final model. It is understood that the configuration of the initial and final structural models has changed, that is, the paths of the initial model relationships are different from the final model ones.

Table 4.
Initial and final integrated model fit indices.

Model Fit Indices	Initial Integrated Model	Final Integrated Model
Chi-square	1399.790	1392.411
Probability level	0.000*	0.000*
CFI – Comparative Fit Index	0.634	0.617
NFI – Standardized fit index	0.509	0.493
GFI – Suitability Index	0.658	0.633
AGFI – Adjusted Fit Quality	0.612	0.587
RMSEA – Root mean squared approximation error	0.100	0.101
RMR – Root mean square residue	0.123	0.079
ECVI – Expected cross-validation index	11.141	11.362
TLI – Tucker-Lewis Coefficient	0.606	0.597

*Significance level: $p < 0,001$

Source: Adapted from De Guimarães et al. (2020).

The path that presented the best Structural Model relationships demonstrated that the interaction between companies is a precursor of PACAP, corroborating the study by Öberg et al. (2020), who stated that business incubator programs should focus more on the interaction between companies. The other precursors initially proposed, such as knowledge of professionals, the capture of knowledge, and use of knowledge, are only confirmed as precursors when they occur following the use of knowledge of professionals from the incubators to help in capturing external knowledge, which, when used by incubated companies, will have a positive impact on their potential absorptive capacity and, therefore, will improve their realized absorptive capacity. As a result, they will have positive influences on the innovativeness and performance of the incubated companies. These findings were also seen in the results of the study by Tang et al. (2019), which concluded that the professional business experience of the incubator team and its links with a wide network help incubated companies to reach a high level of value propositions.

The change in the configuration of the Structural Model had the sole purpose of evaluating the best path of cause and consequence, to identify the precursors and consequences of the ACAP dimensions.

5. DISCUSSION AND CONCLUSION

The results found in this study indicate that the proposed initial model demonstrated that the identified ACAP precursors, the Interaction with Companies (IC), the Professionals' Knowledge (PK), the Capture of Knowledge (CK), and the Knowledge Use (KU) are precursors of PACAP and RACAP, but with low intensity, in Brazilian incubated companies. In addition, PACAP and RACAP reflect little on the innovativeness and organizational performance of Brazilian incubated companies, but PACAP reflects more than RACAP.

Statistical analysis indicates a weak relationship between ACAP's precursors in the business incubation process, and a low relationship between ACAP in innovativeness and organizational performance. This weak relationship of ACAP in the innovativeness and organizational performance was found by several authors (Leal-Rodríguez et al., 2014; Martelo-Landroguez & Cegarra-Navarro, 2014; Raymond et al., 2015; Vicente-Oliva et al.,

2016; Ali & Park, 2016), who stated that PACAP and RACAP only impact innovativeness if there is a combination, that is, PACAP must elevate the level of RACAP in order for them to be an impact in companies' innovativeness. However, the dimensions of ACAP, in order to impact innovativeness, must follow the PACAP and RACAP model, since PACAP is the strongest background factor that impacts innovativeness.

The weak relationships might suggest that the original model proposed is not contributing to the development of ACAP in incubated companies. Due to these weak relationships, a stronger, more promising model was sought, for the process of incubating companies.

After analyses, with the help of the AMOS software, it was identified that Interaction with Companies (IC) and Use of Knowledge (UK) are precursors of PACAP, but Professional Knowledge (PK) and Capture of Knowledge (CK) are precursors of Use of Knowledge (UK). Mainly, Use of Knowledge (UK) as a predecessor of PACAP demonstrated a very high relationship in the proposed new model, and PACAP, a very high relationship with RACAP. Following this model, RACAP was strongly related to Innovativeness and Organizational Performance.

This study suggests that business incubators should, in addition to the services offered to incubated companies, provide both the interaction of incubated companies with other companies and experienced professionals. For interaction between companies, incubators must invest in spaces that encourage this interaction, knowing that through this interaction, companies will exchange experiences and develop their absorptive capacities. And, also, the incubators must make experienced professionals available to accompany the start-up companies, so that these professionals will help in capturing and using important external knowledge for the development of the companies' ideas and of their absorptive capacities.

The results also confirmed that the interaction of companies, the knowledge of professionals, the capture of knowledge, and the use of this knowledge are precursors of ACAP and that PACAP and RACAP will only influence innovativeness and organizational performance when they occur in a combined way as stated in other studies (Leal-Rodríguez et al., 2014; Martelo-Landroguez & Cegarra-Navarro, 2014; Raymond et al., 2015; Vicente-Oliva et al., 2016; Ali & Park, 2016).

Start-up companies, when developing their absorptive capabilities, result in companies with better organizational performance and better innovativeness. For Tidd and Bessant (2015), innovation and entrepreneurship are important for the development of emerging economies.

Through the final proposed model in this research, it was possible to answer the research question regarding which supports must incubators offer their incubated companies for them to develop their own ACAP: increase the interactions among incubated companies who are physically close; ensure professionals, who have knowledge about the incubated companies, develop a close relationship; support incubated companies in acquiring and utilizing external knowledge. These supports will, consequently, lead to companies which are more innovative and have better organizational performance.

5.1. THEORETICAL CONTRIBUTION AND IMPLICATIONS

Studies claim that ACAP influences innovativeness (Cohen & Levinthal, 1989; Caloghirou et al., 2004) and small business performance (Tavani et al., 2014; Kim et al., 2014; Kulkarni, 2015; Lin & Chang, 2015). According to these studies and considering the importance of developing ACAP in incubated companies, this research has a practical contribution: business incubators should review the support they provide to their incubated companies with a view to

developing ACAP. One of the recommendations for business incubator managers corroborates the considerations of the research by Alpenidze et al. (2019), that business incubators should focus on developing strengths by improving their resources and capabilities to establish and maintain strong social and business networks, constantly seeking to attract financial resources.

The statistical results of this research, and the few reports observed in data collection, reinforce that business incubation processes in Brazil must be reassessed so that they can contribute to a more innovative country. The Anprotec study (2019) states that development entities are interested in incubated companies because the incubation programs work systematically on innovation, but this study pointed out that business incubators are not giving adequate support for the incubated companies to become more innovative.

A scenario in which 75% of initial and established entrepreneurs claim that their products or services do not have a differential or novelty in the market in which they operate, as indicated in the GEM survey (2017), already allows us to assume that business incubators are not developing satisfactorily its role in the innovation ecosystem. One should seek to understand how the countries leading the GII list (2018) develop their innovation ecosystems and understand the role of business incubators in the ecosystem of these countries and how they work with their incubated companies to then reverse what was found in the Anprotec 2019 survey that not all incubators have the mission of innovative development, like some work in traditional sectors of the economy.

Financial subsidies, through public policies, are needed for business incubators to provide conditions for them to develop ACAP in their incubated companies. Ordinance No. 6762, of December 17, 2019, of the Ministry of Science, Technology, Innovations, and Communications, established the National Support Program for Innovative Environments (PNI), aiming to consolidate innovation ecosystems in Brazil. Among the guidelines and objectives of the PNI, there are: to attract public or private resources for investment in environments that promote innovation and in companies installed in these environments; to encourage the connection and formation of networks between innovation environments, companies, and national and international entities dedicated to the promotion of innovative ventures; and to encourage the connection between companies located in environments that promote innovation and national industry. These actions will help incubators to develop ACAP in incubated companies.

5.2. PRACTICAL IMPLICATIONS FOR BUSINESS INCUBATORS

One of the recommendations for business incubator managers corroborates the considerations of the research by Alpenidze et al. (2019), that business incubators should focus on developing strengths by improving their resources and capabilities to establish and maintain strong social and business networks, constantly seeking to attract financial resources. The study by Brun (2019) also indicated that the three main contributions that the incubator can offer to the development of incubated companies are: access to resources, business advice, and access to networks. And these are the contributions that Brazilian incubators must provide to their incubated companies.

5.3. LIMITATIONS AND FUTURE RESEARCH

This study was limited by the difficulty of researching a greater number of business incubators and incubated companies due to their unwillingness to respond to academic research. Some questions arising from the findings of this research can also guide other works, such as: what are the main services (access to networks, network development,

infrastructure, business advice, access to financial resources, mentoring, among others) that business incubators should provide to incubated companies to make them more innovative and with good organizational performance in the Brazilian context? What is the contribution of business incubators to the Brazilian innovation ecosystem? Are there other factors that should be considered as precursors of ACAP in incubated companies that were not identified in this study? These are opportunities to develop studies that seek to analyze the innovation ecosystem in Brazil.

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AUTHOR'S CONTRIBUTION

AM: Problem issue definition; conceptual model definition; literature review elaboration; data collection instrument elaboration; analysis of the results and conclusions. **CN:** Data collection instrument elaboration; conceptual model and hypotheses validation; analysis of results and conclusions. **LG:** Analysis of the results and conclusions, general review of the article.

CONFLICTS OF INTEREST

The authors declare there is no conflict of interest in the research.

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