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Antecedents of absorptive capacity: context of companies' incubators in Northeastern Brazil

Ana Lucia Brenner Barreto Miranda and Cristine Hermann Nodari
Universidade Potiguar, Natal, Brazil
Eliana Severo
Centro Universitário UniFBV, Recife, Brazil, and
Julio Cesar Ferro De Guimarães
Programa de Pós-Graduação em Administração (PPGA), Universidade Potiguar – Campus- Roberto Freire, Natal, Brazil

Abstract

Purpose – This research aims at analyzing the antecedents of absorptive capacity (ACAP) in the companies incubated in the State of Rio Grande do Norte, Brazil. In this context, 111 incubated companies took part in the research.

Design/methodology/approach – The methodology used the confirmatory factor analysis and the multiple linear regression to analyze the relationship of the dependent variables (ACAP) with the dependent variables (interaction with other companies, professionals' knowledge (PK), knowledge use (KU) and knowledge acquisition).

Findings – The results highlight that external KU was the construct that most influences the ACAP. Among the dependent variables suggested, only the construct concerning the incubators' PK presented no model significance, which shows that the PK is not an antecedent of ACAP in the incubated companies.

Originality/value – This study is relevant due to pointing out that the incubators may not be providing their professionals with knowledge properly, or that this knowledge is not being accessed by the incubated companies, which allows actions turned to encouraging businesses in this context.

Keywords Absorptive capacity, Antecedents of absorptive capacity, Companies' incubators

Paper type Research paper

1. Introduction

When starting up a new venture, the entrepreneurs' inexperience with the product or market in which they will operate leads them to insert themselves into a business incubation program. In business incubators, the inexperienced entrepreneurs seek help to minimize the challenges of a new venture and rely on experienced professionals and the incubator's relationship networks.

Besides offering support to startups, such as physical facilities, resources and services (Somsuk & Laosirihongthong, 2014), companies' incubators may benefit them with the access to business information (Rubin, Aas, & Stead, 2015; Alpenidze, Pauceanu, & Sanyal, 2019). Companies' incubators work in association with other organizational entities. They are essential for sharing knowledge, experience and contacts with other companies by interconnecting and integrating knowledge and resources from several organizations

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(Chandra, Chao, & Astolpho, 2014). Thus, incubators encourage actions and practices to increase the survival in the initial stages and throughout the organizations' long-term performance (Ratinho, Harms, & Groen, 2013; Lukosiute, Jensen, & Tanev, 2019; Brun, 2019).

The most innovative companies establish relationships with other external economics authors to absorb their experiences and knowledge (Caloghirou, Kastelli, & Tsakanikas, 2004). Cohen and Levinthal (1989) named this external knowledge exploration as absorptive capacity (ACAP), which is the firm's ability to acquire external knowledge to create new knowledge, thus boosting the company's innovative capacity and increasing its competitiveness (Ramos & Zilber, 2015).

Given the importance of ACAPs for the organizational context and the support that business incubators offer their incubatees, it is essential to identify which factors or variables may have antecedents of ACAP in business incubators. This perspective represents a challenge for business incubators to develop the ACAP of their incubated companies. In literature, Volberda, Foss, and Lyles (2010) explained a need for empiric articles that address the ACAP correlations with their descendants, which means a research gap. The research by Minbaeva, Pedersen, Björkman, Fey and Park (2014) corroborates this gap. Such research points out the need to understand how the different element variables affect the development of ACAP by demanding the development of theoretical-empiric ACAP models. Therefore, these notes justify the accomplishment of this research, which will contribute to understanding the importance of incubators in acquiring external knowledge for their incubatees by encouraging the development of the topic. As a theoretical contribution, this article intends to develop a scale to assess the ACAP antecedents and present the influences of the variables over ACAP development in incubated companies. To reach the proposal through systematic research done in databases such as Web of Science and Scopus in April 2018, the authors identified the following variables related to ACAP: interaction between companies, professionals' knowledge (PK), knowledge acquisition (KA) and knowledge use (KU). They emphasize that it did not identify any studies that analyzed the set of these variables as ACAP antecedents in companies, nor did they find studies that identify which variables develop ACAP in incubated companies, which shows the importance of the research.

The criteria used in this systematic research in both bases for selecting the studies comprised the publication of articles in the last five years (2015–2019) with the search topic Absorptive Capacity and Business Incubator in the title, abstract or keyword. The authors identified one hundred thirty-one articles, thirty-five of which on both bases, which resulted in ninety-six articles. The results pointed to a gap in the ACAP antecedents to understand how the different contextual factors affect the development of ACAP in companies (Volberda *et al.*, 2010; Minbaeva *et al.*, 2014).

Therefore, this study aims to analyze the antecedents of ACAP in incubated companies in Rio Grande do Norte (RN), Brazil, by identifying how the variables highlighted in the study behave as ACAP antecedents in incubated companies. It also aims at suggesting a construct scale by taking on the research topic and the appropriate context. According to the National Association of Promoting Entities of Innovative Enterprises (Anprotec, 2019), in Brazil, 363 active incubators house 3,694 incubated companies that have already graduated 6,143 companies.

In this context of incubators' inclusion, it is possible to assume that the services companies' incubators must offer their incubatees are as follows: (1) links with strategic partners, (2) market research, (3) access to the guarantee program, (4) loan funds and (5) network activities, as advocated by Alpenidze, Pauceanu and Sanyal (2019). To these authors, incubated companies access distinct types of knowledge through the incubation process and develop meaningful relationships in a company's initial steps by stimulating their autonomy. Following the same path, the research by Schmutzler and Presse (2021) presents the impact of

the companies' incubation process on German startups. It concludes that these incubators had an ACAP that was significantly higher than that of nonincubated startups. Therefore, the importance of the incubators in the development of ACAP in incubated companies evidences the trend.

This article is thus structured: theoretical framework of the topics concerning ACAP and companies' incubators supported by the presentation of the study hypotheses, research method, results analysis and discussion, followed by the final remarks and the references used in the research.

2. Background

The physical outreach among companies enables interaction and networks, producing collective learning (Chuang, Chen, & Lin, 2016). Companies must interact with other units to improve their learning and ACAP in this environment. Ferreras-Mendez, Newell, Fernández-Mesa and Alegre (2015) claim that the connections with different operations allow the companies to expand technological pools and market opportunities, which help expand the company's exploratory learning.

By bringing their companies together in a single place, companies' incubators enable interactions with the incubated companies, contributing to improving the social capital of these companies. This scenario leads to the following hypothesis:

H1. The interaction with companies (CI) of different operations in the incubator environment is an ACAP antecedent in incubated companies.

To Lin and Chang (2015a, b), companies improve their ACAPs by increasing their efforts in research and development (R&D) and forming R&D alliances with experienced scientists and other measures that can help them with their new technological advances.

Several authors approach the importance of knowing and having experiences about the business or the product in which one will start or develop. Findings of a study by Debrulle, Maes and Sels (2014) state that the owners' initial experience and social capital are positively and meaningfully related to the company's ACAP. This correlation is weaker in volatile environments than in stable ones. For small start-up companies, which have little knowledge, Yoo, Sawyerr and Tan (2016) reinforce, in their studies, how important it is for these companies to activate external resources to improve their knowledge bases.

The knowledge bases in a company will determine its success in acquiring and assimilating external knowledge; this is the potential absorptive capacity (PACAP). The PACAP will boost the effectiveness of transforming and exploring such knowledge; this is the realized absorptive capacity (RACAP) (Larrañeta, Gonzalez, & Aguilar, 2017). Previous experience and accumulated knowledge will influence the ability to internalize external knowledge (Yoo *et al*., 2016).

Learning from previous experiences in R&D projects develops the capacity to access relevant external knowledge (Vicente-Oliva, Martínez-Sánchez, & Berges-Muro, 2016). It is a problem for start-up companies with either no previous learning experience or no accumulated knowledge. For these issues, the incubators are essential for start-up companies since they have experienced professionals who hold the knowledge. This scenario leads to the following hypothesis:

H2. The knowledge of the incubator's professionals is an ACAP antecedent in incubated companies.

As seen above, accessing external knowledge becomes essential for R&D in companies. To Vicente-Oliva *et al*. (2016), companies that will succeed more will be those that can transform external knowledge and apply it to their R&D projects. ACAP improves R&D projects, and

knowledge exploration is the key to improving this result (Vicente-Oliva *et al.*, 2016). It confirms that exploiting external knowledge is critical for company innovation and higher and better performance (Xia & Roper, 2016).

Yoo *et al.* (2016) pointed out that companies searched for external knowledge for innovation when market turbulence was high. However, when the technological turbulence was high, they did not search for it, implying that market turbulence encourages the search for external knowledge. When competitiveness is high, companies do not look for knowledge from suppliers and clients. Companies' incubators can help enterprises to explore and search for crucial external knowledge, which will improve the companies' ACAP. This scenario leads to the following hypothesis:

H3. Incubator help to acquire external knowledge is an ACAP antecedent in incubated companies.

Knowledge sharing positively affects ACAP, and its augmentation improves the baseline projects' performance (Ali, Musawire, & Ali, 2018). Moreover, KA plays the role of a moderator in the innovation activity (Liu, Huang, Dou, & Zhao, 2017). Researchers Ali *et al.* (2018) stated that knowledge sharing does not improve the project performance but leads to developing the project's ACAP, thus improving the flow of information within the organization.

According to Xia and Roper (2016), accessing external knowledge alone will not ensure the company's growth. However, the external knowledge will only benefit a company when associated with its internal resources, which highlights the importance of the RACAP. The capability to learn from external knowledge depends on the company's capacity to increase knowledge diversification and sharing among the employees (Maes & Sels, 2014). Maes and Sels (2014) pointed out that knowledge sharing is related to radical innovation, which shows that Micro and small companies (MSEs) must encourage knowledge sharing.

Xia and Roper (2016) emphasize associating internal and external knowledge with innovation. The companies will be more competitive when they bring the external knowledge together with the internal one (Yoo *et al.*, 2016). Since internal knowledge is essential to obtain, retain and use the external knowledge (Lichtenthaler, 2016), the higher the ACAP is, the more the practical knowledge transfer will be (Minbaeva *et al.*, 2014). Therefore, companies' incubators help enterprises with the use of externally acquired knowledge, and this scenario leads to the following hypothesis:

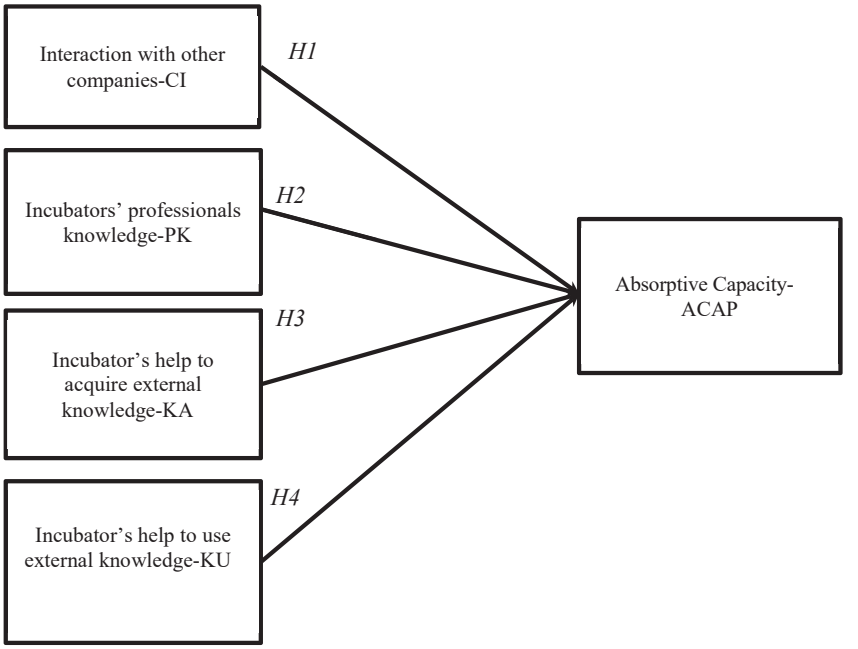
H4. Incubator help to use external knowledge is an ACAP antecedent in incubated companies.

The authors present the conceptual model in Figure 1, according to complementary material.

3. Method

This research is quantitative, and the researchers must collect their data to test the hypotheses based on the numerical measurement and statistical analysis (Perovano, 2016). According to Hair, Black, Babin, Anderson and Tatham (2009), the main feature of quantitative analysis is the quantification in collecting and processing the information created using statistical techniques, avoiding analysis and interpretation distortions. Moreover, it ensures a higher safety margin concerning interferences.

The authors have conducted this research with incubated companies in RN, the sixth Brazilian state with the highest number of incubators in the Northeastern Region with the largest number of them. The Northeast Region of Brazil concentrates the highest



Source(s): Designed by the authors (2020)

Figure 1.
Theoretical framework

number of federal universities (twenty units), followed by the Southeast, with nineteen universities, which helps a lot in highlighting the insertion of incubators.

RN has twenty-two companies' incubators, with twenty technological incubators that belong to higher teaching institutions and two social incubators that belong to social cooperatives. Of the incubators that belong to higher teaching institutions, only one is private, the remaining are public, and two social incubators are private. In the companies' incubators, over 140 companies are in the incubation process – preincubation, incubation or graduation.

The authors performed the research with all the incubated companies in Northeastern Brazil. Access to these incubated companies occurred by contacting the companies' incubators and through the information available about the incubated companies on the companies' incubators' site. The authors sent an e-mail to the incubators introducing the research for data collection. This e-mail asked the incubated companies to forward a link made available with the questionnaire to be answered, resulting in 111 replies. Therefore, the sample is characterized as nonprobabilistic by convenience (Hair *et al.*, 2009).

The questions were designed based on the literature analyzed to measure the factors and answer the hypotheses raised. The questionnaire comprised twenty-five questions that the respondents analyzed concerning their level of importance to the statements, according to the 5-point Likert scale: (1) not important, (2) barely important, (3) important, (4) very important and (5) extremely important. The interval Likert scale is a number scale that defines variables' order. The authors operationalized the research through a 5-point Likert scale based on principles by Byrne (2010) and the study by De Guimarães, Severo, Henri Dorion, Coallier and Olea (2016). They emphasized that the Likert scale initially has no continuous distribution, but when used in a sum-total way, it partly meets the requirement

concerning continuity. Therefore, it suits the measurement of the observable variables (questionnaire).

Developing a scale with the measurement model composed of the observable variables grouped up into factors is an essential contribution to the organizational studies related to ACAP and the process of companies' incubation. The confirmatory factor analysis (CFA) is vital as a predecessor of hypothesis tests measured by multiple linear regressions (MLRs).

In this sense, the authors used the CFA for data analysis to check the consistency of the scale suggested. They used the MLR to analyze the correlation of the dependent variable (ACAP) with the independent variables, as suggested in the theoretical model (CI, KU, PK and KA), to verify the consistency of the suggested scale. According to Hair *et al.* (2009), the multiple linear regression uses measures to explore the correlation among the variables studied. The authors performed the statistical processing and data analysis through the SPSS® (Statistical Package for Social Sciences) software, version 21, for Window®.

4. Results' analysis

The research encompassed 111 incubated companies that comprise the twenty-two incubators in the State of RN. Of the companies researched, 80% are technological and 20% are social companies that are part of the social incubators belonging to social cooperatives. Concerning incubation time, 50% of the respondents have been under the incubation process for up to one year, 15% for one year, 30% for two years and 5% for four years.

At first, CFA was used to check the structure's expected level of satisfaction, the model suggested (Hair *et al.*, 2009). The authors initially processed the data to discard outliers, which showed that there were no data to be discarded. The authors performed the following to check data normality and reliability: Bartlett's sphericity test, with a significance of $p < 0.001$; the Kaiser-Meyer-Olkin (KMO) adequacy measure, with values higher than 0.5; and the sample reliability verification of the observable variables of the Cronbach's Alpha, with a value higher than 0.7.

The authors used the Cronbach's Alpha with 0.70 as the most acceptable lower level (Hair *et al.*, 2009) to assess the scale consistency. According to the reliability test results, it is possible to see that the variable concerning PK was the only factor with a value below 0.7 (0.665). According to complementary material, the remaining factors are above 0.7 (Table 1, according to complementary material).

The authors used the Pearson correlation analysis of the five factors to check the multilinearity, i.e. if there are variables with a correlation above 0.8 (Hair *et al.*, 2009). According to the Pearson Correlation Matrix of the factor concerning CI (Interaction with other companies), there is no multicollinearity among the variables. The highest correlation was 0.687 between variable CI1 (Upon housing their incubated companies in the same physical space, companies' incubators enable the CI) and CI2 (The incubated companies' physical outreach enables interactions that contribute to improving the social capital of these incubated companies).

Factor (construct)	Number of questions	Cronbach's Alpha
CI (interaction with other companies)	5	0.858
PK (professionals' knowledge)	5	0.665
KA (knowledge acquisition)	5	0.777
KU (knowledge use)	5	0.708
ACAP (absorptive capacity)	5	0.767

Source(s): Research data (2019)

Table 1.
Internal consistency of the factors identified

The Pearson Correlation Matrix of the factor concerning PK also shows no multicollinearity among the variables. The highest correlation was 0.560 between the variable PK1 and the variable PK3. In the variable PK1, the companies' incubators are essential for the incubated companies since they have experienced professionals and have the knowledge that will help incubated companies. In the PK3 variable, the experience of incubators professionals helps incubated companies access relevant external knowledge to develop new operations or products.

The Pearson Correlation Matrix presented no multicollinearity between the variables for the factor referring to KA (External KA). The highest correlation was 0.705 between the variables KA1 and KA2. In the variable KA1, the companies' incubators can help incubated companies to explore necessary external knowledge. In the variable KA2, companies' incubators can help incubated companies assimilate necessary external knowledge. Likewise, the Pearson Correlation Matrix of the factor concerning KU presented no multicollinearity among the variables. The highest correlation was 0.471 between the variables KU2 (External knowledge will only benefit an incubated company when it is associated with the internal resources of these incubated companies) and KU5 (The incubated company's internal knowledge is essential to acquire, retain and use the external knowledge acquired).

The Pearson Correlation Matrix of the factor concerning ACAP has shown no multicollinearity among the variables. The highest correlation was 0.577 between the variables ACAP1 and ACAP2. In the variable ACAP1, incubated companies have limitations in acquiring relevant knowledge, and in the variable ACAP2, assimilating new knowledge is essential for incubated companies.

After the reliability tests and Pearson's correlation matrix, the authors checked the data adequacy for this study's AFC.

The Bartlett's sphericity test, which checks the presence of correlations among the variables (Hair *et al.*, 2009), showed statistical significance among the variables with $p < 0{,}001$, which shows data normality, as shown in Table 2 (according to complementary material). According to Hair *et al.* (2009), Bartlett's statistically significant sphericity test (sign. < 0.5) shows that there are enough correlations among the variables to carry on with the analysis. The KMO test, which suggests the items' variance proportion that can be explained by a latent variable (Lorenzo-Seva, Timmerman, & Kiers, 2011), presented a value of 0.821. It means suitability for the use of CFA. It is worth mentioning that, based on a 5-point Likert scale and a sample with 111 respondents, the authors measured the "non-normality" confirmation possibility, which one can observe through the KMO and Bartlett's sphericity tests. However, this study was unable to confirm the non-normality of the data. Therefore, the research data may be normal. According to Marôco (2011), the recommendations concerning the KMO values about AFC are 0.9 to 1.0 – excellent; 0.8 to 0.9 – good; 0.7 to 0.8 – average; 0.6 to 0.7 – mediocre; 0.5 to 0.6 – poor but acceptable and below 0.5 – unacceptable.

The communality matrix shows the variability percentage of each variable. The authors used the communality matrix to check the variation that an observable variance shares with all the other variables in the research (Severo, de Guimarães, & Dorion, 2018). Experts must rule out values below 0.5 (Hair *et al.*, 2009) since the variable has a weak explanation power.

Sample adequacy's Kaiser-Meyer-Olkin measure		0.821
Bartlett's sphericity test	Chi-square approximation	1216.762
	gl	300
	Sig	0.000

Source(s): Research data (2019)

Table 2.
KMO test and Bartlett's sphericity test

Factor		Mean	Standard deviation	Factor load	Communality
CI (interaction with other companies)	CI1	4.15	0.808	0.782	0.669
	CI2	4.17	0.781	0.815	0.736
	CI3	4.21	0.796	0.764	0.662
	CI4	3.95	0.868	0.625	0.525
	CI5	4.09	0.742	0.787	0.725
PK (professionals' knowledge)	PK1	4.03	0.934	0.724	0.599
	PK2	4.03	0.963	0.764	0.621
	PK3	3.94	0.933	0.747	0.689
	PK4	3.71	0.821	0.465	0.580
	PK5	3.79	0.843	0.425	0.594
KA (knowledge acquisition)	KA1	4.05	0.792	0.638	0.662
	KA2	3.90	0.849	0.569	0.723
	KA3	3.94	0.820	0.692	0.657
	KA4	4.03	0.811	0.661	0.586
	KA5	3.84	0.855	0.441	0.415
KU (knowledge use)	KU1	3.55	0.889	0.550	0.518
	KU2	3.38	1.101	0.841	0.719
	KU3	4.16	0.812	0.575	0.717
	KU4	3.93	0.779	0.471	0.439
	KU5	3.96	0.884	0.707	0.649
ACAP (absorptive capacity)	ACAP1	4.47	0.710	0.705	0.741
	ACAP2	4.45	0.733	0.787	0.703
	ACAP3	4.03	0.765	0.431	0.592
	ACAP4	3.94	0.841	0.489	0.471
	ACAP5	4.11	0.787	0.579	0.586

Source(s): Research data (2019)

Table 3. Mean, standard deviation, communality and factor load

Table 3 (according to complementary material) presents the communality values and the variables' factors load of the factors.

Upon analyzing the factorial load through the intrablocks' CFA, it was possible to see that the questions concerning CI2 and KU2 presented the highest factor loads, 0.815 and 0.841, respectively, which shows that these questions contribute the most to explaining the construct. In the questions concerning CI2, the incubated companies' physical outreach enables interactions that contribute to improving the social capital of these incubated companies. In the questions concerning KU2, external knowledge will only benefit an incubated company when it is associated with these companies' internal resources.

The question concerning CI2 confirms the findings by authors Chuang *et al.* (2016), who mentioned the importance of physical outreach among companies to facilitate interaction and network creation. On the other hand, the question concerning KU2 confirms the findings by authors Xia and Roper (2016), who stated that accessing external knowledge is not enough; companies must associate with their internal resources.

The lowest factor loads, with values below 0.5 and with few contributions to the construct, were those from questions concerning

(1) PK4 (The knowledge bases that exist in the company will determine the success of acquiring and assimilating external knowledge, which will boost the efficacy to transform and explore such knowledge), with a factor load of 0.465;

(2) PK5 (Incubated companies improve their ACAP by increasing their efforts in R&D through the acquisition of experienced PK about R&D), with a factor load of 0.425;

(3) KA5 (Market turbulence encourages the search for external knowledge), with a factor load of 0.441;

(4) KU4 (The capability to learn from external knowledge depends on the incubated company's capability to encourage knowledge sharing among the employees), with a factor load of 0.471;

(5) ACAP3 (External KA and assimilation contribute to the incubated companies' projects in the long run), with a factor load of 0.431; and

(6) ACAP4 (The transformation of external knowledge encourages the application of new techniques and structures in incubated companies), with a factor load of 0.489.

The questions concerning PK5 and ACAP3 stand out, with the lowest loads. Authors Lin and Chang (2015a, b) stated that the experienced scientists' knowledge might help starting companies in R&D efforts, thus improving the company's ACAP, which is the focus of the question concerning PK5. As this question does not contribute to the construct, the suggestion is that the incubated companies' managers are not bearing any contributions from incubated experienced professionals. In their studies, authors Popaitoon and Siengthai (2014) concluded that acquiring and assimilating external knowledge is vital for projects in the long term. Considering that this factor load is low, it is known that incubated companies are starting companies that have not yet realized how the knowledge acquired can contribute to the long term.

ACAP1 and ACAP2 presented the highest means and lowest standard deviations, which means there was high agreement in the answers. However, the question concerning KU2 presented the lowest mean and the highest standard deviation, which means there was low agreement in the answers.

According to the communality test result, the authors removed three questions that presented values below 0.5, questions KA5, KU4 and ACAP4. The factor solution does not adequately explain these variables. After removing the variables with low values, the authors performed MLR to assess the influence of the independent variables (CI, PK, KA and KU) over the dependent variable (ACAP). In other words, the authors used MLR to check if there is any CI, the incubated PK, the use of external knowledge and if the application of external knowledge is an ACAP antecedent. In the regression results for the model suggested, R^2 shows the percentage in which the independent variable explains the dependent variable. The results show that the independent variables explain the dependent variable in 48%, according to Table 5. The Durbin-Watson statistic value, which tests the autocorrelation among the regression mistakes or residuals (Marôco, 2011) and that d must be brought closer to 2, presented a $d = 1.643$. According to complementary material, there is no autocorrelation among the residuals (Table 4).

Table 4. Multiple linear regression

R	*R*-squared	Adjusted *R*-squared	Standard error of the estimate	Durbin-Watson
0.692[a]	0.480	0.460	0.41102	1.643

Source(s): [a]Predictors: (Constant), MedUC, MedIE, MedCC, MedCP

Table 5. ANOVA

	Sum of squares	Gl	Mean square	*F*	Sig
Regression	16.653	4	4.163	24.644	0.000[b]
Residual	18.076	107	0.169		
Total	34.730	111			

Source(s): [b]Predictors: (Constant), MedUC, MedIE, MedCC, MedCP

The Analysis of Variance (ANOVA) test presented a statistical significance for the Regression performed with $p < 0.001$, according to Table 5 (according to complementary material). It recommends that the regression estimate model is adequate for the study, which results in a meaningfully statistic model [$F(4.107) = 24.644$; $p < 0.001$; $R^2 = 0.480$]. The ANOVA test had statistical significance for the Multiple Linear Regression (RLM) performed with $p < 0.001$.

The t test showed that the factor concerning PK presented no statistical significance, with $p > 0.001$ and a standardized Beta value of −0.065, which shows a negative coefficient value. It means it is not an ACAP antecedent. Upon analyzing the standardized Beta values, it is possible to see that the factor concerning KA (external KA) is a stronger predictor due to having the highest coefficient, of 0.371.

Concerning collinearity statistics, which may show a strong correlation among the independent variables, the variance inflation factor (VIF) must be close to 1 and it cannot be higher than 10. The tolerance value must be above 0.2. The proposed model's VIF values are between 1.31 and 1.87, and the tolerance values are above 0.53, which shows no collinearity. It is possible to see that the highest VIF value and the lowest tolerance value belong to the variable concerning PK.

With the MLR analysis, the authors can state that among the ACAP antecedent factors in the companies' incubators, there is the CI, the acquisition of external knowledge, and the use of external knowledge, which consistently confirms H1, H3 and H4. However, they reject H2 because the tests showed that the PK of the incubators is not an ACAP antecedent.

5. Results and discussion

To meet the research objective, the authors suggested a model representing the correlation of the ACAP antecedents in incubated companies in the state of RN. Through the meta-analysis performed, the authors identified the following as ACAP antecedents:

(1) the CI of distinct types of business in the incubators' environment (CI),

(2) the PK in the incubator (PK),

(3) the incubator help to acquire external knowledge (KA) and

(4) the incubator help to use external knowledge (KU).

H1 addressed the CI of different operations in the incubator's environment as an ACAP antecedent. It confirmed studies by Aribi and Dupouët (2015) and Chuang *et al.* (2016), when they stated that the interaction among companies, which is enabled by the physical outreach, develops the companies' social capital that is adequate to accumulate, keep and move knowledge. Incubated companies are under the same roof in companies' incubators, which provides interaction among them.

The confirmation of H3, which states that the incubator's help to acquire external knowledge is an ACAP antecedent, was also found in studies by Vicente-Oliva *et al.* (2016) and Xia and Roper (2016). In these studies, the acquisition of external knowledge improved the companies' R&D projects and presented them as necessary for their innovation and performance.

H4, which focused on the incubator's help for the use of external knowledge as an ACAP antecedent, was also confirmed. According to studies by Xia and Roper (2016) and Yoo *et al.* (2016), acquired external knowledge is made possible only when associated with internal knowledge. However, incubators can help in this association of external and internal knowledge.

Only H2 has not been confirmed. The PK of incubators was not confirmed as an ACAP antecedent, which refutes the results of studies by Lin and Chang (2015a, b), Debrulle *et al.* (2014), and Vicente-Oliva *et al.* (2016). This perspective makes it possible to know that incubated

companies may not be able to have access to the incubators' professionals who have the knowledge that can help with the success of such companies.

To identify the contribution of each independent variable in the construct, the authors calculated the MLR for each construct (CI, PK, KA and KU) together with the ACAP mean to check the contribution of each question and their influence over ACAP. Table 6 (according to complementary material) shows the standardized Beta values of the MLRs performed.

Upon analyzing Table 7, the authors ruled out independent variables that contributed little to the ACAP influence and presented values below 0.2. The lowest coefficient values that the authors ruled out referred to the following questions: CI2, CI5, PK1, PK2, PK4, KA3, KA2, KU1 and KU2. The authors suggested a new scale to analyze CI, PK, KA and KU as ACAP antecedents with 14 questions, which kept the questions related to the following factors: ACAP1, ACAP2, ACAP3 and ACAP5; CI1, CI3 and CI4; PK3 and PK5; KA1 and KA4; and KU3 and KU4. We present these questions in Table 1.

6. Conclusion

This study aimed to analyze the antecedents of ACAP in incubated companies in RN, Brazil. The suggested model showed that CI, PK, KA and KU are ACAP in companies' incubators in the state of RN. Upon performing the CFA and the MLR tests, it was possible to identify that only one hypothesis presented no significance. It was rejected, which is characterized by the incubators' PK antecedent. The results found confirm the remaining hypotheses tested. Moreover, one can conclude that CI, KA and KU are ACAP antecedents in companies' incubators in RN. On the other hand, KA was the strongest predictor, and we can state that it is the antecedent that contributes to ACAP the most.

The nonconfirmation that the PK of incubators does not improve the ACAP in incubated companies contradicts several authors who published studies that showed that experienced professionals could help companies in their initial phase (Debrulle *et al.*, 2014; Vicente-Oliva *et al.*, 2016). Their studies have also shown that experienced professionals could improve the knowledge bases in companies when starting their businesses (Yoo *et al.*, 2016; Larrañeta *et al.*, 2017). As experienced professionals assist companies' incubators, should one try to understand why these professionals are not backing up incubated companies?

The suggestion of scale validation contributes to organizational studies linking ACAP to the distinct business incubation process. This study highlights the antecedents of ACAP in companies incubated through managerial contributions. It points out a crucial factor in the incubation process: the knowledge of incubators professionals that is not being adequately made available by incubators or accessed by incubated companies. As theoretical contributions, this research confirmed that companies' interaction, PK, KA and use are ACAP antecedents. Scientific bases found no similar studies that confirmed these factors as ACAP antecedents in incubated companies. Concerning its academic contribution, the study was able to statistically validate the scale (questions) and the research constructs, which can be helpful to other research.

As limitations in this study, it should be emphasized that, upon using the Likert scale in the research along with the subjective measures in the questionnaire (self-responded) to collect data about several variables at the same time, the common-method variance (CMV) may occur due to the interviewee's exposition to one single technique and tool for data collection. Another limitation in the research is using statements with a leveled scale (5-point Likert scale), leading to biased answers, as in the Halo effect. This wrongful generalization comes from providing answers to one characteristic, quality, object or person and the social desire influence that can increase or decrease the correlations between the constructs. The absence of a control variable is another limitation in this study. Due to sample diversification, the regression method may require a control variable. Moreover, as the authors did not do the

Table 6.
Beta coefficients

Model	Nonstandardized coefficients		Standardized coefficients			Correlations			Collinearity statistics	
	B	Standard error	Beta	*t*	Sig	Zero-order	Partial	Part	Tolerance	VIF
(Constant)	1.217	0.322		3.772	0.000					
MedCI	0.314	0.070	0.358	4.475	0.000	0.533	0.397	0.312	0.759	1.317
MedPK	−0.062	0.091	−0.065	−0.681	0.497	0.431	−0.066	−0.047	0.535	1.870
MedKA	0.320	0.075	0.371	4.260	0.000	0.568	0.381	0.297	0.642	1.557
MedKU	0.192	0.073	0.224	2.632	0.010	0.473	0.247	0.184	0.673	1.486

Note(s): a. Dependent variable: MedACAP
Source(s): Research data (2019)

Questions	Standardized Beta coefficients
CI1	0.118
CI2	0.072
CI3	0.152
CI4	0.291
CI5	0.047
PK1	0.019
PK2	0.032
PK3	0.209
PK4	0.175
PK5	0.204
KAI	0.213
KA2	0.109
KA3	0.100
KA4	0.314
KU1	0.062
KU2	−0.018
KU3	0.399
KU5	0.213

Source(s): Research data (2019)

Table 7. Standardized Beta coefficient in the questions

pretest with the managers in incubated companies, it may suggest a limitation concerning methodological and cognitive aspects regarding situational variations and research samples. However, this was the research path to have access to incubated companies.

Despite the justification of the research's object clipping in RN, another limitation lies in implicit characteristics that may interfere with the findings (e.g. economic, social, cultural and environmental characteristics). Some questions from these research findings can also guide other works, such as stratifying the primary services that companies' incubators may offer to incubate companies by encouraging the ACAP, such as access to financial and teaching resources.

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Corresponding author
Ana Lucia Brenner Barreto Miranda can be contacted at: analuciabrenner@yahoo.com.br