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DETERMINANTS OF INNOVATION IN MICRO AND SMALL ENTERPRISES: A MANAGEMENT APPROACH

Determinantes da inovação em micro e pequenas empresas: Uma abordagem gerencial

Determinantes de la innovación en micro y pequeñas empresas: Un enfoque de gestión gerencial

ABSTRACT

The article sought to evaluate the impact of management factors on the innovation capability of micro and small enterprises (SMEs). A total of 315 SMEs were analyzed in Pernambuco in the period 2015–2016. The following internal factors were considered: leadership, people management, information and knowledge, customer relationship, business-society relationship, results, age, and size. The innovation capability was measured by the degree of sectoral innovation. The relationships were analyzed by means of multiple linear regression and data envelopment analysis. The results demonstrated that leadership, information and knowledge, customer relationships, and society positively influence innovation capability and its efficiency.

KEYWORDS | Innovation capability, determinants of innovation, micro and small businesses, data envelopment analysis, multiple linear regression.

RESUMO

O artigo buscou avaliar o impacto de fatores gerenciais sobre a capacidade inovativa de micro e pequenas empresas (MPEs). Analisaram-se 315 MPEs em Pernambuco, no período 2015-2016. Foram considerados como fatores internos: liderança; gerenciamento de pessoas; informações e conhecimentos; relacionamento com clientes e sociedade; resultados; idade; tamanho. A capacidade inovativa foi mensurada pelo grau de inovação setorial. As relações foram analisadas por meio de regressão linear múltipla e análise envoltória de dados, cujos resultados demonstraram que a liderança, informações e conhecimentos, relacionamento com clientes e a sociedade influenciam positivamente a capacidade inovativa e sua eficiência.

PALAVRAS-CHAVE | *Capacidade inovativa, determinantes da inovação, micro e pequenas empresas, análise envoltória de dados, regressão linear múltipla.*

RESUMEN

El artículo tiene como objetivo evaluar el impacto de los factores gerenciales sobre la capacidad innovadora de micro y pequeñas empresas (MYPE). Se analizaron 315 MYPE en Pernambuco, en el período 2015-2016. Se consideraron como factores internos: liderazgo; gestión de personas; información y conocimiento; relaciones con los clientes y la sociedad; resultados; edad; y tamaño. La capacidad innovadora se midió por el grado de innovación sectorial. Las relaciones se analizaron mediante regresión lineal múltiple y análisis envolvente de datos, los resultados mostraron que el liderazgo, la información y conocimiento, y las relaciones con los clientes y la sociedad influyen positivamente en la capacidad innovadora y su eficiencia.

PALABRAS CLAVE | *Capacidad innovadora, determinantes de la innovación, micro y pequeñas empresas, análisis envolvente de datos, regresión lineal múltiple.*

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INTRODUCTION

Innovation represents the search for novelty that enables organizations to increase their competitiveness and face competition (Schumpeter, 1988). The ability to innovate is seen as an important element for the performance of organizations and the economic sector, since it allows the market to leave the steady state. According to this author, large organizations have access to greater business opportunities and find it easy to innovate because they have a superior management structure.

Micro and small enterprises (MSEs) face difficulties in accessing technological resources because they have fewer resources and limited capacities, (Laforet & Tann, 2006), which restrict their innovation capability. This capability results from several capacities developed by the firm, such as technological, operational, managerial, and commercial capabilities (Zawislak, Alves, Tello-Gamarra, Barbieux, & Reichert, 2012). If on the one hand, MSEs have constraints on those capabilities driven by technology, then on the other hand the business-driven capabilities, such as managerial and commercial, can be crucial for developing innovation and gaining a competitive advantage. Therefore, obtaining a greater understanding of the innovation stage in MSEs and how managerial and business capabilities can foster innovation are beneficial to these organizations. Thus, studying this issue is essential to understanding how different factors act and impact organizational performance (Ganau & Maria, 2014).

Therefore, it is necessary to know the resources associated with the capacities and analyze their impact on the innovation capability of the firm. Based on the Resource-Based View (RBV) (Wernerfelt, 1984), authors such as Bayarçelik, Taşel, and Apak (2014), Genis-Gruber and Öğüt (2014), and Jong and Vermeulen (2006) analyzed this relationship, evaluating the importance of managerial factors in the development of innovation in small companies. They demonstrated the relevance of aspects, such as leadership (Bayarçelik et al., 2014), financial results (Bayarçelik et al., 2014), and customer orientation (Genis-Gruber & Öğüt, 2014).

Despite the focus on managerial aspects, the authors adopt a limited perspective of organizational management and do not understand how several managerial factors and their interactions influence innovation. Moreover, cultural and sectoral aspects can affect established relationships (Genis-Gruber & Öğüt, 2014). Managerial aspects of innovation remain scarcely exploited (Kamasak, 2015), and the absence of studies addressing these relationships in SMEs in developing countries contributes to this gap (Elj & Abbassi, 2014).

In this context, this work proposes to answer the following research question: Which factors related to organizational management impact the innovation capability of MSEs?

From the development of the research, we intend to get to know the managerial factors that propitiate the innovation, allowing the organizations to identify and develop the necessary capabilities for the activity. Also, analyzing the stage of innovation of the MSEs makes it possible to understand the differences before large organizations, stimulating the development of public policies focused on needs.

THEORETICAL FRAMEWORK

The competitive advantage obtained by the firm can be understood in terms of the dynamic capabilities it develops (Teece, 2007; Teece, Pisano, & Shuen, 1997) and its ability to build and reconfigure internal and external competencies to respond rapidly to environmental changes.

In this sense, innovation can be seen as an expected result of having such capacities, since innovation capability is a special resource of the firm that leads it to the achievement of competitive advantage and, consequently, of extraordinary profits (Schumpeter, 1988).

According to Guan and Ma (2003), the firm's innovation capability is related with internal experiences and experimental acquisition. It is related with the "ability to absorb, adapt and transform a given technology into specific management, operations, and transaction routines that can lead a company to Schumpeterian profits" (Zawislak et al., 2012, p. 15).

These authors see the innovation capability as a result of the set of capabilities, driven by technology and business. In the technological context, it is possible to find the capacity to apply knowledge to transform resources into products through routines, that is, technological development and operational capabilities. In the business context, in turn, it is possible to find the capacity of the firms to launch developed solutions in the market with a low transaction cost, that is, managerial and commercial capabilities.

Although firms have all four capabilities, one of them is expected to dominate over a certain period (Zawislak et al., 2012). Although MSEs do not have deep knowledge and skills to develop and operate a new technology (Laforet & Tann, 2006), their managerial and commercial capability can be decisive to innovate. Their management structure allows them to have flexibility and entrepreneurial attitude, which could facilitate innovation (Scherer, 1988).

As Teece (2007) points out, managerial and organizational competencies enable the firm to gain competitive advantage and to transform continually to maintain this advantage. These

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competencies are central elements of the dynamic capabilities (Teece et al., 1997), and greatly important for the innovation performance (Alves, Barbieux, Reichert, Tello-Gamarra, & Zawislak, 2017). Therefore, the company's decision about its innovation process depends on the organizational structure and the management resources (Ganau & Maria, 2014), while external resources complement this capacity (Teece, 2007).

The model proposed by Zawislak et al. (2012) uses the RBV, in which innovation is the result of the combination of the firm's capacities and resources, affected by market conditions. Therefore, the firm's capability results from the deployment of resources in combination through organizational processes to achieve the desired end (Amit & Schoemaker, 1993). Therefore, analyzing the effects of managerial and commercial capability on the innovation capability of MSEs involves analyzing the managerial and commercial resources (here called managerial factors), that is, specific assets controlled by the firm, that allow developing innovation.

Determinants of innovation capability

Reichert, Camboim, and Zawislak (2015) define managerial capability as "the set of skills and routines to carry out the overall task of coordinating the business and its resources" (p. 166), which refer to the ability to manage assets and activities, seeking efficiency. Commercial capability, in turn, refers to the ability to put into operation marketing and trading processes (Reichert et al., 2015), whose resources allow the transaction cost to be reduced (Williamson, 1985).

Sharing the RBV, a literary review was carried out that allowed the identification of six constructs through an exploratory approach. These constructs represent the managerial factors capable of influencing the innovative performance: (i) leadership; (ii) people management; (iii) information and knowledge; (iv) customer relationship; (v) business-society relationship; and (vi) results.

Furthermore, we also considered the variables size and age, given their relevance in the studies analyzed. The determinants considered are not intended to exhaust managerial factors, but rather to exemplify their multidimensionality.

Leadership

According to Schumpeter (1988), the entrepreneur is the transforming agent who, in search of bigger profits, develops innovation and induces economic development. The author emphasizes the importance of the entrepreneur in innovation, which is explored by Bayarçelik et al. (2014) when demonstrating that the management practiced by the leaders is a component of the capability of organizational innovation.

The experiences and knowledge acquired by the leaders influence this capability (Elj & Abbassi, 2014; Farace & Mazzota, 2015; Romijn & Albaladejo, 2002), and also the management style can facilitate and promote its development (Bayarçelik et al., 2014). After all, leadership can "provide resources and expertise, reduce bureaucratic layers, and promote collective understanding and interpersonal trust" (Bayarçelik et al., 2014, p. 206)

Thus, the maintenance of dynamic capability also requires the ability of entrepreneurs and managers to create special value by combining assets in the firm (Teece, 2007), thus the following research hypothesis is proposed:

> H1: Leadership positively influences the innovation capability of MSEs.

People management

As it is an interactive process, innovation requires the combination of different knowledge and points of view (Söllner, 2010). Human capital diversity can positively affect innovation generation in the organization (Farace & Mazzota, 2015; Söllner, 2010), which shows the importance of people management in the innovative process. These authors demonstrated that innovation capability depends on the abilities of the entrepreneurs, as well as of the employees.

Management practices of selection, training, and employee motivation tend to contribute to innovation. As Lehtoranta (2005) and Laforet (2011) point out, the process of recruiting skilled labor leads to an environment conducive to change, which promotes well-being in the enterprise and, consequently, results in innovation, allowing the proposition of the following hypothesis:

> H2: People management positively influences the innovation capability of MSEs.

Information and knowledge

Gathering information allows the reduction of information asymmetry and, consequently, of transaction costs (Williamson, 1985) and provides valuable advantages for achieving innovative performance (Kamasak, 2015).

Workforce skills become more important as the awareness of the role of internal and external networks in the organization grows (Farace & Mazzotta, 2015). The establishment of networks

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promotes the sharing of knowledge between firms (Jong & Vermeulen, 2006), sharing the risks associated with innovations, which are highly onerous and risky to be undertaken alone (Love & Roper, 2001).

Such consequences are not only perceptible in relations with technological and research centers. The relationship with suppliers and competitors can offer the company advantages in obtaining valuable information and knowledge (Kamasak, 2015).

The absorption of information and knowledge from the network is capable of leading to innovation (Laforet, 2011), providing opportunities to develop radical and sustainable innovations. Besides, it is possible that network activities can influence other managerial aspects (Love & Roper, 2001) since their use without investing in other resources will not result in superior innovative performance. For this reason, the following research hypothesis is proposed:

> H3: Information and knowledge obtained by MSEs positively influence their innovation capability.

Customer relationship

The search for information about customers and the market allows the company to understand its needs better, facilitating the development of innovation and its acceptance in the market (Jiebing, Bin, & Yongjiang, 2013). The ideas and information the company receives from customers, through satisfaction surveys, for example, can help identify needs and provide customized products (Jiebing et al., 2013).

Customer relationship is important in the development of new ideas and product launches, process and organizational innovations, and business strategy (Genis-Gruber & Öğüt, 2014; Kamasak, 2015; Laforet, 2011). It allows the identification of opportunities in a more efficient way, reducing the risks of innovation, which supports the following research hypothesis:

> H4: Customer relationship positively influences the innovation capability of MSEs.

Business-society relationship

Regulatory issues are seen as inhibiting and also facilitating innovation. Although it is an external factor to the company, the attendance to regulatory, social, and environmental aspects can contribute to the innovation capability.

For Nidumolu, Prahalad, and Rangaswami (2009), companies that comply with regulations become more proactive to innovate, since knowledge and compliance with regulatory issues can be used as a source of competitive advantage. Companies that comply with the most stringent regulations (whether economic, social or environmental), even before they are applied, have substantial advantages in terms of innovation (Nidumolu et al., 2009).

These authors emphasize regulatory aspects and sustainability as a driver of innovation. Companies that seek sustainability increase the chances of becoming a leader in the innovation process (Deloitte, 2013), as this allows approaching a point of view differently and exploring new ideas. In this sense, the following hypothesis is developed:

> H5: Business-society relationship positively influences the innovation capability of MSEs.

Results

For Bayarçelik et al. (2008) the company's innovation capability is associated with its resources, especially the ones related to financial factors, supporting the studies of Lecerf (2012), Laforet (2011), and Romijn and Albaladejo (2002). These studies point out to the influence of financial factors on innovation, agreeing with the Schumpeterian perspective that considers credit a necessary condition for innovation.

Sustainable financial performance allows the retained profit to be invested in innovation, and also makes leverage possible to carry out the activity. Souza-Pinto (2015) emphasizes not only the importance of the result per se but also draws attention to the controls on financial and non-financial results to improve innovation performance, supporting the following hypothesis:

> H6: Results obtained by MSEs positively influence their innovation capability.

Age

The age of the company represents the experience and the knowledge accumulated throughout its history and is related to the best management of communication, creativity, and the capability of absorption (Galende & Fuente, 2003). As it allows to measure the experience and the learning of the companies, age is used to measure the organizational resources (Ganau & Maria, 2014). Thus, it is expected that older companies are more likely to innovate, given the accumulated knowledge and experience, supporting the following hypothesis:

> H7: Age positively influences the innovation capability of MSEs.

On the other hand, Thornhill (2006) found negative effects of age on innovation, related to the obsolescence effect identified by Sorensen and Stuart (2000). As firms mature, they develop

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routines and skills that are used to innovate and facilitate the learning process (Dosi, Nelson, & Winter, 2000). However, as they focus on these competencies, they become obsolete, making innovation difficult (Sorensen & Stuart, 2000).

Size

According to Schumpeter (1988), firm size determines innovation, since larger firms have a superior management structure that facilitates access to business opportunities (Thornhill, 2006). Thus, larger firms have more opportunities to develop innovations and benefit from their results.

> H8: Size positively influences the innovation capability of the MSEs.

The determinants addressed in this research are compatible with the organizational characteristics discussed by Souza-Pinto (2015) through the framework of the absorptive capability of Machado and Fracasso (2012). However, the literature review allowed the inclusion of new variables and the exclusion of others, leading to the design of the eight research hypotheses, according to Exhibit 1.

Exhibit 1. **Research hypotheses**

Hypothesis	Description
H1	Leadership positively influences the innovation capability of MSEs.
H2	People management positively influences the innovation capability of MSEs.
H3	Information and knowledge obtained by MSEs positively influence their innovation capability.
H4	Customer relationship positively influences the innovation capability of MSEs.
H5	Business-society relationship positively influences the innovation capability of MSEs.
H6	Results obtained by MSEs positively influence their innovation capability.
H7	Age positively influences the innovation capability of MSEs.
H8	Size positively influences the innovation capability of MSEs.

METHODOLOGY

The present section aims at demonstrating the method used to reach the proposed goal.

Population and research sample

The population used in this study consisted of MSEs participating in the Local Agent of Innovation (ALI) program, located in Pernambuco, during 2015 and 2016. We considered as MSEs those organizations covered in the Complementary Law No. 123 (2006).

Out of the 2,838 companies participating in the program in 2016, 315 were randomly selected, providing a 5.21% error and a 95% confidence level. For the selection, the most representative segments in the program were prioritized: food industry, furniture, clothing, gastronomy, and tourism industry. The data used refers to the initial diagnosis performed by the program, before the effective participation of the company, so that the actions developed by the ALI did not affect the results obtained.

Although the sample was not stratified between the segments, it does not show any discrepancy between the frequencies of the groups, being representative of the population, as demonstrated in the Chi-square test ($x^2 = 3.714$, with a significance level of 0.466 and $\alpha = 0.05$).

Econometric model

The purpose of this paper is to identify and quantify the impact of managerial factors on the innovation capability of MSEs. Therefore, multiple regression consists of an appropriate statistical method, allowing to determine the effect (quantity and direction) of the independent variables on the dependent variable (Galende & Fuente, 2003). Given the suitability of the method to the objective, Kamasak (2015) and Galende and Fuente (2003) used multiple regression to measure the impact of different variables on innovation.

The equation below presents the proposed econometric model:

$$CI_{i,t} = \alpha + \beta_1 X_{n,i,t} + \beta_2 Age_{i,t} + \beta_3 Size_{i,t} + \beta_4 Sector_i + \varepsilon_{i,t} \quad (1)$$

where:

$CI_{i,t}$: innovation capability of the firm i at time t; α is the constant; $X_{n,i,t}$: managerial factors n of firm i at time t; $Tamanho_{i,t}$: neperian logarithm of the age of firm i at time t; $Idade_{i,t}$: neperian logarithm of firm size i at time t; $Setor_i$: dummy referring to the sector of the company i; e $\varepsilon_{i,t}$: error term referring to company i at time t .

For tabulation and analysis, the software packages Statistical Package for the Social Sciences (SPSS®) version 21 and STATA® version 12 were used.

Independent variables

The managerial factors, considered independent variables in the model, were composed of the constructs presented in the literary review. Moreover, a dummy variable referring to the economic sector was included in the regression.

The constructs were measured by the arithmetic mean of different components, which reflect the different aspects considered in the literature, based on the structured questionnaire provided by the ALI, used by Vasconcelos, Mello, and Melo (2016). The components are described in Exhibit 2.

Exhibit 2. **Internal factors related to organizational management**

Dependent variables	Nº components	Aspects considered by the components
Leadership	7	It analyzes how managers exercise leadership and invest in managerial development. It observes the formulation of the mission, communication, and information sharing with employees and the promotion of innovation.
People	5	It observes the definition of roles and responsibilities in the firm. It considers the selection and empowerment of people, the risks, and hazards associated with work, and the well-being practices carried out by the organization.
Information and knowledge	3	It analyzes the information necessary to carry out the company's activities and to make decisions. It observes the sharing of knowledge and the use of comparative information in performance analysis.
Customers	5	It verifies how the needs and expectations of potential and current customers are identified, how the products' promotion is conducted, and how customer relationship is maintained.
Society	3	It analyzes the management practices of the company in relation to society by complying with legal requirements, environmental and social aspects.
Results	6	It analyzes the results presented by the company, relating to customers, employees, main processes and financial performance.

Dependent variable

Many of the studies that analyze innovation capability associate it with technological innovation, research and development or patents. However, different companies may have different types of innovation throughout life cycles, not necessarily associated with technology (Alves et al., 2017).

Therefore, innovation capability was analyzed through the innovation radar to approach innovation holistically (Bachmann & Destefani, 2008; Sawhney, Wolcott, & Arroniz, 2006), as shown in Exhibit 3.

Exhibit 3. **Dimensions of innovation radar**

Dimension	Definition
Offerings	Development of new products or services for the market.
Platform	Sharing of components, methods or technologies to make the production system more adaptable to the products or services offered.
Brand	Use of the brand to leverage new market opportunities.
Customers	Discovery of new segments or unmet needs.
Solutions	Custom and integrated combination of goods, services and information capable of solving customer problems.
Customer experience	Formulation of the customer experience and its interface with the organization.
Value capture	Capturing the created value by discovering untapped revenue streams or by interacting with customers and partners.
Processes	Change of the activities of operations internal to the company to obtain greater efficiency, better quality or faster cycle time.
Organization	Changes in the structure of the company, in the role of employees and partnerships.
Supply chain	Logistics aspects of the business.
Presence	New forms of commercialization and/or distribution to make the products available.
Networking	Improvements in communication resources to increase the value of the company.
Innovative environment	Sources of knowledge in innovation used by the company.

Source: Based on Sawhney et al. (2006) and Bachmann and Destefani (2008).

Thus, the innovation capability was analyzed in a wide way and can occur in any dimension of the business system, since in all of them, opportunities to innovate that are capable of generating value for the organization can be found. Furthermore, it is possible to observe an association between the 13 dimensions of the innovation radar and the seven dimensions of the innovation capability proposed by Guan and Ma (2003).

Innovation capability was measured by the Degree of Sectorial Innovation (DSI) proposed by Oliveira, Cavalcanti, Paiva, and Marques (2014) to incorporate the heterogeneity of the sectors to which the companies belong. Thus, the impact of the dimensions of each segment of the organization was calculated using equations 2 and 3.

$$GI_{Mt} = \sum_{k=1}^{13} p_k D_{Mk} \quad (2)$$

$$CI_{i,t} = GIS_{it} = \frac{\sum_{k=1}^{13} p_k D_{ik}}{\sum_{k=1}^{13} p_k D_{Mk}} \quad (3)$$

Where:

GIS_{Mt}: degree of sectorial innovation for sector M at time t; GIS_{it}: degree of sectorial innovation of the firm i at time t;D_{ik}: value of innovation dimension k for firm i;D_{mk}: value of innovation dimension k for sector M; p_k: weight of innovation dimensions k.

The weight of the innovation dimension p_k is obtained by:

$$\max \sum_{k=1}^{13} p_k D_{Mk} \quad (4)$$

subject to:

$$\sum_{k=1}^{13} p_k = 1$$

$$p_k \geq 0{,}05 \quad for\ \forall k$$

$$D_{Mk} p_k \leq 0{,}5 \quad for\ \forall k$$

Data envelopment analysis

Although regression represents a good method for analysis, derived models can provide misguided prediction measures (Klimberg, Lawrence, Yermish, La, & Mrazik, 2009), since the relative weight of independent variables can vary between comparable units.

Thus, the determinants of innovation were also evaluated by the Data Envelopment Analysis (DEA), calculating the importance of each factor for the weights that assign the highest possible score for each firm evaluated, providing a better breakdown of the explanatory variables. The DEA allowed the identification of the organizations that obtained optimal allocation between the determinants of innovation (inputs) and the innovations generated (outputs), that is, that obtained efficiency.

The DEA analyzed the input to observe the efficiency in the use of the resources in the generation of the innovation capability. Therefore, the managerial factors were the inputs of the model, while the innovation dimensions were the outputs. It was also assumed that the model does not require constant returns of scale, since an increase in the inputs can promote increase or decrease in the output, not necessarily proportional. Therefore, the variable-scale return model (Banker, Charnes, & Cooper, 1984) was used, using MaxDEA® software in version 6.13.

Table 1. **Sample composition**

		Nº of companies	Frequency
Sector	Food industry	71	22.5%
	Furniture	53	16.8%
	Clothing	68	21.6%
	Gastronomy	66	21.0%
	Hotel and Tourism	57	18.1%
Age	1-5	127	40.3%
	6-15	111	35.2%
	16-25	56	17.8%
	25	21	6.7%
Size	1-10	182	58.0%
	11-20	71	22.6%
	21-40	44	14.0%
	40	17	5.4%
Region	Metropolitan Region of Recife	273	86.7%
	Other regions of the state	42	13.3%

RESULTS

In this section, the research results are presented and discussed.

Descriptive statistics

In Table 1, it is possible to observe that the distribution of the sample shows a higher concentration in the food industry segments and lower concentration in the furniture industry. However, as stated, the frequencies between the segments do not show statistical differences, according to Chi-square test.

About 40% of MSEs analyzed have been in existence for between one and five years; lower the frequency, greater the age range, revealing a tendency to mortality over the years (Brazilian Service of Support to Micro and Small Enterprises [SEBRAE], 2013). It was observed that 58% of companies have up to 10 employees, and that the lower the frequency, the bigger the size. A higher concentration of companies (86.7%) in the Metropolitan Region of Recife (RMR) was observed, and the other regions (south coast, north coast, agreste, and sertão) represented 13.3% of the sample.

Innovation capability

Table 2 presents the dimensions of the innovation radar, related to the innovation capability of the firms. It is possible to observe that the innovations developed by the MSEs that were analyzed do not cover equally all dimensions of the radar. On the contrary, there is a concentration in certain activities, revealing that MSEs find it easy or difficult to innovate in some dimensions.

The expressiveness of the "supply" and "platform" dimensions reveal the focus on product innovations. As pointed out by Nooteboom (1994), the prioritization of product innovations, especially in market niches, aims at overcoming the shortcomings before the large companies.

Although the innovations developed by the MSEs are not related to technological innovation, it is possible to observe that the analyzed companies are engaged in activities of development of new products and services, new operational arrangements, seeking proximity to customers and stakeholders, as contemplated by commercial innovations (Reichert et al., 2015).

Unlike the firms analyzed by Guan and Ma (2003), the results suggest that MSEs seek to focus on core innovation assets rather than supplementary assets. Innovations prioritized by

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MSEs (supply, platform, customers, relationship, network) are related to the manufacturing and marketing capability related to core assets. Less prioritized innovations (supply chain, organization, processes, innovative environment), in turn, are related to the firm's capacity to support and harmonize the basic capability for innovation to effectively play its role regarding supplementary assets.

Table 2. **Average of innovation dimensions by segment**

Dimension	Food industry	Furniture	Clothing	Gastronomy	Hotel/ Tourism	All segments
Offerings	2.74 *	3.40 *	2.97	3.34 *	2.08	2.91
Platform	4.41 *	4.57 *	4.54 *	4.06 *	4.16 *	4.34
Brand	3.01 *	2.45	3.69 *	3.76 *	3.64 *	3.34
Customers	2.15 *	3.04 *	3.07 *	2.49	2.95	2.71
Solutions	1.46	2.66	2.28	1.77	3.03 *	2.19
Customer experience	2.13	2.11	3.24	2.64 *	3.78 *	2.77
Value capture	1.27	1.75	1.79	1.83	1.55	1.63
Processes	1.64	2.13	1.99	1.68	2.33	1.93
Organization	1.64	2.26	2.11	2.13	2.63	2.13
Supply chain	1.42	2.13	1.88	2.00	2.66	1.99
Presence	1.18	1.55	1.79	1.38	2.38	1.64
Networking	1.56	2.89 *	2.24	1.36	3.86 *	2.31
Innovative environment	1.72	2.16	1.75	1.94	2.52	1.99

*p_k>0.05

Although supplementary assets complement core assets, they are crucial for the firm to achieve competitiveness sustainably. The low engagement of MSEs in these innovations can contribute to a lower performance before large companies.

Table 2 also shows the most relevant dimensions for each segment (p_k>0.05), obtained by equation 4, in which it is possible to visualize similarities and differences in the profile of the innovations. The "offering," "platform," and "brand" dimensions are relevant for most segments; the "customers" dimension is considered critical for the food, furniture, and clothing industry segments; and "solutions" is relevant for the hotel and tourism segment. The "customer experience" dimension stands out in the clothing, gastronomy, and hotel and tourism segments; and "networking" is impressive for furniture and hotel and tourism.

By the averages and weights (p_k) obtained, the degree of sectorial innovation (DSI_{Mt}) was calculated using equation 2. Obtaining the DSI_{Mt} made it possible to incorporate the characteristics of the respective segments in the evaluation of the innovation capability, and to make comparisons between them.

While hotel and tourism was the most innovative segment, the food industry appears to be the least innovative. The Kruskal-Wallis test demonstrates that the differences between the means of the segments are significant. Compared to Oliveira et al. (2014), DSI growth is observed in all segments between the period analyzed by these authors (2010-2011) and of this research (2015-2016), demonstrating a commitment to the development of innovations.

Table 3. **Degree of sectorial innovation**

	Food industry	Furniture	Clothing	Gastronomy	Hotel / Tourism
Degree of Sectorial Innovation (DSI_{Mt})	2.39*	2.83*	2.90*	2.71*	3,20*

*significant difference for a *p-value*<0.05 according to the Kruskal-Wallis test

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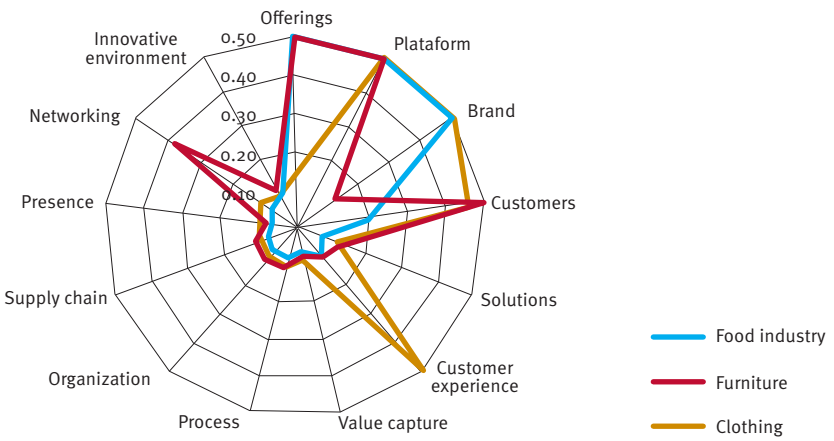
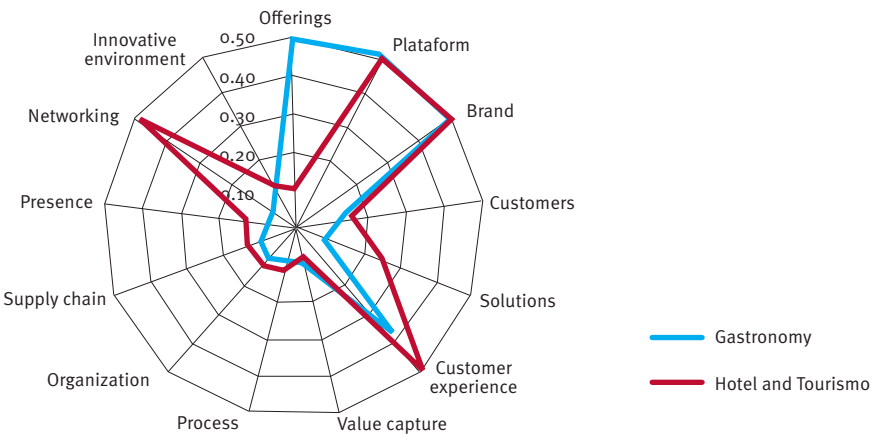
Graphs 1 and 2 present the innovation dimensions for the industry and service sectors, by measuring the weight (p_k) and the mean innovation size for the segment (D_{Mk}). Despite the differences between innovation intensities, it is possible to identify similarities between the segments studied. While innovations in core assets were prioritized, they received few investments in industry and service in the supplementary assets.

Graph 1. **Radar of innovation for the industry sector**



Graph 2. **Radar of innovation for the service sector**



Regression results

DSI_{it} was calculated for each company using equation 3, representing the innovation capability ($CI_{i,t}$). As proposed in the model, the $CI_{i,t}$ refers to the dependent variable, and the managerial factors refers to the independent variables.

Table 4 shows the correlation matrix of the analyzed variables. All dependent variables have a positive correlation with innovation capability, agreeing with the literature. However, managerial factors are also positively and moderately related to each other, since the development of one management resource can foster another (Jong & Vermeulen, 2006; Love & Roper, 2001). Despite the correlation, no multicollinearity was found in the regression.

Table 4. **Spearman Correlation**

	Leadership	Customers	Society	Info. and know.	People	Results	*ln*Age	*ln*Size	DSI_{it}
Leadership	1								
Customers	0.582	1							
Society	0.498	0.266	1						
Info. and know.	0.628	0.614	0.410	1					
People	0.650	0.459	0.94	0.536	1				
Results	0.438	0.518	0.187	0.419	0.383	1			
Ln Age	0.036	-0.211	0.133	-0.098	0.067	-0.062	1		
Ln Size	0.264	0.08	0.259	0.112	0.326	-0.009	0.252	1	
GIS_{it}	0.485	0.382	0.394	0.496	0.371	0.208	0.07	0.213	1

Table 5 shows the results of the multiple linear regression and assumptions for the 315 companies. The proposed model presented good predictive power, with R^2 of 33.6%, superior to the models of Alves et al. (2017), Farace and Mazzota (2015), Ganau and Maria (2014) and Galende and Fuente (2003). Although this study focuses only on managerial and commercial resources, the variables considered presented good explanatory power about the firm's innovation capability.

Table 5. **Multiple linear regression**

Variable	Coefficient	*p-value*	Collinearity	
			Tolerance	FIV
Constant	0.700	0.000 *		
Leadership	0.084	0.009 *	0.398	2.514
Customers	0.051	0.098 **	0.468	2.136
Society	0.071	0.006 *	0.658	1.519
Information and knowledge	0.146	0.000 *	0.459	2.177
People	-0.024	0.467	0.480	2.083
Results	-0.017	0.196	0.580	1.723
*Ln*Age	0.015	0.251	0.744	1.344
*Ln*Size	0.015	0.133	0.797	1.254
Sector	-0.013	0.539	0.702	1.424
R^2	0.336			

Dependent variable: GIS_{it}

*p-value<0.05 **p-value<0.10

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The regression result showed that "leadership," "customers," "society," and "information and knowledge" had a positive and significant impact on innovation generation, emphasizing the importance of these resources for the development of dynamic capability. However, the variables "people," "results," "age," and "size" were not relevant.

The significance of the variable "leadership" corroborates with Teece (2007), who considers the entrepreneur an important component of dynamic capability. His previous experiences, knowledge, and skills play a crucial role in the development of innovation (Farace & Mazotta, 2015; Romijn & Albaladejo, 2002).

Obtaining customer information allows to know their needs and identify opportunities to develop new products or services. Therefore, customer relationship is a source of innovation (Genis-Gruber & Öğüt, 2014; Kamasak, 2015; Laforet, 2011). Similarly, knowledge of regulatory, social, and sustainable aspects allows organizations to think differently and develop new ideas, achieving superior innovative performance (Nidumolu et al., 2009).

The behavior of the variable "information and knowledge" was consonant with Farace and Mazzota (2015), Kamasak (2015), and Jong and Vermeulen (2006). Information retrieval and sharing can be used to improve or develop new products or services, new marketing methods, to reduce the risks of the innovation process and the transaction costs (Williamson, 1985).

However, the knowledge and experience acquired by the employees did not have a significant impact on the innovation capability. Stiffness in task definition and execution and the capacities that reinforce operational skills can slow down the development of innovation. The results suggest that employees make a limited contribution to the innovation processes, given the restriction of their activities to common tasks (Elj & Abbassi, 2014).

The innovation capability of the firms analyzed seems not to be affected by the results obtained by the companies. It was also observed that many of the MSEs analyzed do not have financial control, so this is not related to innovation. The Schumpeterian hypothesis that size positively influences the innovation capability of firms has also not been confirmed in the regression, thus disengaging this capacity from the possession of these resources. Contrary to what is proposed in the literature, the "age" variable did not influence the innovation of MSEs, but it is consistent with the works of Genis-Gruber and Öğüt (2014) and Kamasak (2015).

These results demonstrate the relevance of obtaining these resources and capacities for the competitiveness of the MSEs. However, as expected, only part of the innovation capability is explained by them, revealing the importance of aspects external to the organization to innovate. After all, more than accumulated experiences and resources acquired (Galende & Fuente, 2003; Ganau & Maria, 2014), innovation capability is mainly the result of strategic decisions (Hadhri, Arvanitis, & M'henni, 2016).

Data envelopment analysis results

For DEA, we considered the significant variables in the regression, since the wrong specification of the model may affect the quality of the results (Klimberg et al., 2009). The analysis of the decision-making units showed that the sample had an average efficiency of 0.86, in which 174 companies were considered efficient and 141 companies were not efficient regarding innovation capability.

Table 6 shows the contribution of outputs to efficiency. In general, it is observed that the "offerings," "platform," "processes," and "innovative environment" dimensions have a greater contribution to the efficiency of the innovation capability.

Product innovations, addressed in the "supply" and "platform" dimensions, allow MSEs to explore new market niches and overcome their shortcomings, as pointed out by Nooteboom (1994). On the other hand, innovations in processes and environment are associated with changes in the productive and managerial processes, in obtaining new sources of knowledge that can generate reductions in information asymmetry and transaction costs (Willianson, 1985).

Table 6. **Contribution of outputs**

Outputs	Contribution
Offerings	11%
Platform	16%
Brand	8%
Customer	5%
Solutions	9%
Customer experience	8%
Value capture	3%
Processes	10%
Organization	7%
Supply chain	5%
Presence	3%
Networking	4%
Innovative environment	11%

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While the results obtained by DSI demonstrate the innovations prioritized by MSEs, the results obtained by DEA demonstrate the innovations that contribute to the efficiency of this capability.

By comparing GIS and DEA, it is possible to observe that innovations valued by firms are not necessarily the ones that contribute most to their efficiency. Innovations in processes and innovative environment, related to supplementary resources were not relevant in any of the segments studied. However, DEA has demonstrated that they are among the innovations that most contribute to the efficiency of the firm's capacity, suggesting a mismatch in the innovation strategies practiced by MSEs.

Table 7 shows the contribution of the inputs, in which it is possible to observe the importance of leadership, customers, society, and information and knowledge for the efficiency of the innovation capability, as found in the regression.

Table 7. **Contribution of inputs**

Inputs	Contribution
Leadership	27%
Customers	20%
Society	31%
Information and knowledge	22%

While "information and knowledge" showed a higher coefficient in the regression, it showed the lowest contribution in the DEA. These differences reflect the analysis method used by the models, since DEA generates a different set of weights for each company, whose estimates are less affected by the correlations of the variables (Klimberg et al., 209).

Therefore, using DEA in the regression may result in better prediction estimates (Klimberg et al., 2009). Tables 8 and 9 show the results of the regressions for efficient and inefficient firms.

Table 8. **Multiple regression for efficient firms**

Variable	Coefficient	p-value	Collinearity	
			Tolerance	VIF
Constant	0.800	0.000 *		
Leadership	0.090	0.013 *	0.460	2.172
Customers	0.084	0.019 *	0.497	2.012
Society	0.095	0.001 *	0.758	1.319
Information and knowledge	0.178	0.000 *	0.468	2.136
Sector	-0.028	0.001 *	0.757	1.320
R^2	0.497			

Dependent variable: GIS_{it}

*p-value<0.05

Table 9. **Multiple regression for inefficient firms**

Variable	Coefficient	*p-value*	Collinearity	
			Tolerance	VIF
Constant	0.717	0.000 *		
Leadership	0.052	0.123	0.541	1.847
Customers	0.012	0.691	0.646	1.547
Society	0.071	0.021 *	0.741	1.350
Information and knowledge	0.203	0.000 *	0.557	1.796
Sector	-0.018	0.010 *	0.978	1.023
R^2	0.409			

Dependent variable: GIS_{it}

*p-value<0.05

The addition of efficiency in the regression increased the explanatory power of the model (R^2 = 49.7 for the efficient firms and R^2 = 40.9 for the inefficient firms) when compared to the regression presented in Table 5. The significance of the sectoral dummy indicates that the innovation capability in the industry is lower than in the service sector.

While the regression of efficient firms showed results close to the regression without DEA, inefficient firms showed some distinctions. It is observed that the innovation capability of inefficient companies is determined by their compliance with the norms and regulations of the sector and the information obtained by knowledge networks.

However, "leadership" and "customers" were not significant, indicating that inefficient firms may have difficulty in transforming customer information into innovation and in using the leaders' experiences and knowledge in this process.

Efficient development of innovation was the only significant variable, which reinforces the importance of these resources for organizational competitiveness. The figure of the entrepreneur that is close to the customer is related to the discovery of new opportunities, identification of improvements, and coordination of resources (Teece, 2007), which are central resources for the development of innovation and profit-making.

Exhibit 4 summarizes the results obtained for the hypotheses of the study.

Exhibit 4. **Results of the research hypotheses**

Hypothesis	Description	Results	
		Efficient	Not efficient
H1	Leadership positively influences the innovation capability of MSEs.	+	N / S
H2	People management positively influences the innovation capability of MSEs.	N / S	N / S
H3	Information and knowledge obtained by MSEs positively influence their innovation capability.	+	+
H4	Customer relationship positively influences the innovation capability of MSEs.	+	N / S
H5	Business-society relationship positively influences the innovation capability of MSEs.	+	+
H6	Results obtained by MSEs positively influence their innovation capability.	N / S	N / S
H7	Age positively influences the innovation capability of MSEs.	N / S	N / S
H8	Size positively influences the innovation capability of MSEs.	N / S	N / S

N/S: non-significant relationship
+: significant and positive relationship

CONCLUSIONS

This study aimed at analyzing the influence of management factors on the innovation capability of MSEs, and measuring their impact. To this end, the present study integrated the perspectives of the RBV (Bayarçelik et al., 2014; Genis-Gruber & Öğüt, 2014; Kamasak, 2015; Wernerfelt, 1984) and dynamic capability (Alves et al. 2017; Teece et al., 1997; Zawislak et al., 2012) approaches to discuss innovation capability.

Although Teece et al. (1997) suggest that the formulation of excess strategies may lead to disinvestment in dynamic capabilities, the present article shows that the formulation of efficient strategies of innovation can occur through the investments in dynamic capabilities and the central resources of management.

Thus, the skills needed to develop the innovation capacities addressed by Zawislak et al. (2012) have been "translated" into a series of resources that can be manipulated by the firm. These resources allow the identification and measurement of abstract capabilities, enabling firms to obtain the necessary resources for competitiveness in terms of innovation.

Although the study adopted a limited perspective of the model of Zawislak et al. (2012) because it focuses only on resources related to managerial and commercial capabilities, the results emphasize its importance for obtaining competitive advantage in MSEs. This perspective is important as many studies focus on large organizations, where technological resources are prioritized. As MSEs face difficulties in accessing and operating technologies, the article demonstrates that managerial and commercial capabilities become decisive for innovating.

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Thus, the study suggests that the innovation capability resulting from dynamic capabilities lies not only in the figure of the entrepreneur and the strategic management exercised, as proposed by Teece (2007), but it is also associated with information and knowledge obtained by knowledge networks, and customer relationship and business-society relationship.

Although innovation is associated with entrepreneurial activity (Schumpeter, 1988), the figure of the leader may be insufficient to generate competitive advantage, thus the acquisition of other resources is necessary. Likewise, the results also suggest the existence of barriers that do not allow MSEs to use financial resources and the skills of employees to generate innovation, which may be responsible for the low development of supplementary innovations associated with sustainable growth (Guan & Ma, 2003). However, we observed that the nature of the data prevented a dynamic analysis of established relationships. The data reveal the manager's perception of the company, not necessarily the organizational reality.

Finally, we emphasize that the internal perspective is responsible for only a part of the innovation capability. Further studies proposing models analyzing other capacities, as well as environmental variables, would obtain greater explanatory power. Moreover, the use of other econometric methods, such as data panel or quantum regression, would result in more robust results.

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