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Analysis of strategic behavior in micro and small technology–based firms in brazil

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Abstract

This study aimed to identify some of the main characteristics of strategic behavior in micro and small technology–based firms in Brazil and consisted of two phases. The former involved a survey of 104 micro and small technology–based firms, with results obtained using multivariate statistical techniques. The latter involved five case studies, with information collected through semi-structured interviews and were analyzed using the content analysis technique. The results indicated that micro and small technology–based firms operate in sectors with significant levels of dynamism and uncertainty and exhibit strategic behavior based on the adoption (or implementation) of competitive and innovation strategies, structuring of R&D departments, and R&D investments to meet customer needs. The influence of dynamic capabilities on the innovation process may enable micro and small technology–based firms operating in uncertain and dynamic sectors to sense external opportunities and seize and reconfigure organizational resources to exploit external opportunities for competitive advantages.

Keywords Strategic behavior · Innovation strategy · R&D investments · Micro and small technology–based firms

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Resumen
Este estudio tiene como objetivo identificar algunas de las principales características del comportamiento estratégico en micro y pequeñas empresas de base tecnológica en Brasil. El método de investigación empleado constó de dos fases. En la primera, se realizó una encuesta a 104 micro y pequeñas empresas de base tecnológica, cuyos resultados se obtuvieron mediante la aplicación de técnicas estadísticas multivariadas. La segunda consistió en cinco estudios de caso, con información recogida mediante entrevistas semiestructuradas y analizada mediante la técnica de análisis de contenido. Los resultados indican que las micro y pequeñas empresas de base tecnológica operan en sectores con importantes niveles de dinamismo e incertidumbre y presentan un comportamiento estratégico basado en la adopción (o implementación) de estrategias competitivas y de innovación, la estructuración de los departamentos de I+D y las inversiones en I+D para satisfacer las necesidades de los clientes. La influencia de las capacidades dinámicas en el proceso de innovación puede permitir que las microempresas y las pequeñas empresas de base tecnológica que operan en sectores inciertos y dinámicos perciban las oportunidades externas y aprovechen y reconfiguren los recursos organizativos para explotar las oportunidades externas y obtener ventajas competitivas.

Palabras clave Comportamiento estratégico · estrategia de innovación · inversiones en I+D · microempresas y pequeñas empresas de base tecnológica

JEL Classification C10 · L25 · M10 · O32

Summary highlights

Objective This study aims to identify the key aspects of strategic behavior in micro and small technology–based firms.
Methodology The methodology employed in this study comprised two phases. The first phase involved a survey of 104 micro and small technology–based firms, with the results obtained through applying multivariate statistical techniques. The second phase encompassed five case studies, with data collected through semi-structured interviews, and was analyzed using content analysis techniques.
Results This study indicated that the strategic behavior of the micro and small technology–based firms can be initially described by the definition of competitive and innovation strategies and the formalization of competitive strategy only. Subsequently, the allocation of organizational resources for innovation and the development of dynamic capabilities were identified as factors/resources, such as knowledge and experiences accumulated by leaders and employees, the development of competitive and innovation strategies, strategic partnerships with external agents (especially customers), investments in R&D, the establishment and maintenance of R&D departments, and the ability to interact with the market. Finally, sectoral characteristics may influence strategic behavior, especially dynamism, uncertainty, and technological obsolescence.
Contributions This study contributes to the frontier of knowledge on strategic management in micro and small enterprises by comparing and identifying the influence

of competitive and innovation strategies and dynamic capabilities on the strategic behavior of micro and small technology–based firms. For leaders of micro and small technology–based firms, this study shows that technology-intensive sectors are dynamic, uncertain, and characterized by a high degree of technological obsolescence. Therefore, for their companies to survive and gain a competitive advantage, this study highlights the essential resources required to thrive in such an environment and the primary means of adapting organizational resources to meet market opportunities and external demands, especially from customers.

Limitations The first limitation was during the quantitative phase, specifically because of the difficulty in obtaining registration information for MPEBTs in São Paulo. As no public or private institutions were found to provide complete distribution of these companies by the municipalities, obtaining information gradually and sporadically was necessary. The second limitation is the selection of cases for the qualitative stage. As micro and small enterprises operate in various sectors and market segments, the investigated companies belong to different segments, except for two companies operating in the medical-ophthalmological products segment. Therefore, in case selection, only industrial companies from the sample were considered, and companies operating in the service sector were not studied in the qualitative stage.

Future contributions Future studies can further explore the relationships between environmental dynamism and uncertainty in developing competitive and innovative strategies and using dynamic capabilities for innovation.

Introduction

In contemporary competitive scenarios, where technological developments and new customer demands exacerbate economic uncertainties, enterprises must develop new sources of knowledge to innovate and achieve competitive advantages over competitors (Haapanen et al. 2018; Verreynne et al. 2019). Moreover, enterprises must understand their environments to survive in these markets (Turulja and Bajgoric 2019).

Environmental characteristics can compel enterprises to find new ways to interact with external variables and reconfigure resources and capabilities to develop or improve processes, products, and/or services (Haapanen et al. 2018). According to Ansoff (1983), strategic behavior refers to the interaction among external environmental factors, accompanied by a process that promotes the modification of internal dynamic aspects. Complementarily, Scherer and Mussi (2000) stated that the analysis of strategic behavior encompasses the analysis of the external environment and internal structure of an organization.

Strategic approaches supported by analyses of external and internal organizational environments can enable companies to understand their characteristics and adopt competitive and innovative strategies for competitive advantage and appropriate growth conditions (Aramand and Valliere 2012).

Micro and small technology–based firms (STBFs) have played an outstanding role in job creation, socioeconomic development, dissemination of scientific and technological knowledge, and support for the innovation process in many countries (De Massis et al. 2018).

Studies on STBFs must consider that these enterprises have organizational specificities related to their size, such as limited resources and a lean organizational structure; therefore, STBFs must be based on theories compatible with such characteristics (Cho et al. 2017; De Oliveira and Terence 2018). However, these specificities should not obstruct the development of these companies or their adoption of innovation strategies (De Oliveira and Terence 2018; Ko and Liu 2017).

Regarding the influence of innovation strategy development, allocation of organizational resources, and development of dynamic capabilities on innovation performance in micro and small companies, Anzules-Falcones and Martin-Castilla (2020) investigated the factors affecting the development of innovation strategies in 207 Ecuadorian companies operating in the services sector. The results obtained through a survey indicated that the development of innovation strategies depends on resource allocation, market analysis, internal communication, organizational structure, and marketing. Batra et al. (2018) analyzed the relationship between strategic planning and innovation strategies in 162 small Indian manufacturing companies. The results showed that strategic planning and organizational learning influence innovation strategies. Cho et al. (2017) identified the main variables influencing innovation strategies in 20 Korean STBFs. The results showed that R&D investment is the primary variable that influences innovation strategies. De Oliveira and Terence (2018) investigated the innovation practices identified in STBFs during the incubation and post-incubation periods. The results obtained from the four case studies showed that STBFs with significant levels of innovation tend to make incremental innovations in processes, products, and/or services. Haapanen et al. (2018) investigated how the allocation of organizational resources influences the achievement of sustainable competitive advantages in Finnish STBFs. The results obtained from the eight case studies indicated that R&D investments, marketing, and companies' ability to formulate competitive strategies constitute the primary resources for obtaining competitive advantages. Haddad et al. (2019) explored how innovation strategies help managers of micro and small businesses in Dubai and the United Arab Emirates achieve their performance goals. The results indicated that developing innovation-driven organizational cultures and identifying customer needs constitute the primary strategic resources that assist managers in achieving their performance goals. Ko and Liu (2017) investigated the contributions of competitive strategies and dynamic capabilities to obtain a competitive advantage in STBFs. The results obtained through a survey of 214 STBFs in the UK indicated that developing competitive strategies supports the development of dynamic capabilities and R&D investments. Lin and Lai (2021) presented the main factors affecting the development of technological capabilities in Taiwanese micro and small companies. The results obtained through a survey of 509 companies showed that organizational learning and technological collaboration were the main factors affecting the development of technological capabilities. Lukovszki et al. (2020) identified the corporate functions that contribute the most to the innovative success of micro and small companies with limited

resources. The results obtained through a survey of 784 companies in Bosnia and Herzegovina, Colombia, Costa Rica, the Czech Republic, France, Hungary, Mexico, and Spain indicated that efficient management of companies and investment in R&D are the variables that contribute to the most innovative success of micro and small companies.

Considering that strategic behavior is formed by the interaction among the variables that constitute external and internal organizational environments (Scherer and Mussi 2000), the studies in this literature review separately present the influence of variables on strategic behavior in STBFs. For example, the variables of competitive strategies and innovation were indicated by Anzules-Falcones and Martin-Castilla (2020), Batra et al. (2018), Cho et al. (2017), and Haapanen et al. (2018). R&D investments were mentioned by Cho et al. (2017), Ko and Liu (2017), and Lukovszki et al. (2020). Strategic planning was indicated by Batra et al. (2018), and knowing the customer's need was cited by Haddad et al. (2019).

This study aims to identify a few of the main components of strategic behavior in STBFs to complement the analysis of the articles mentioned above and present the external and internal variables that influence strategic behavior globally. Strategic behavior analyses are based on variables such as the definition of competitive and innovation strategies, R&D investments, allocation of organizational resources, quantities and types of innovations, and development of dynamic capabilities. The development of dynamic capabilities is analyzed based on the dimensions of sensing, seizing, and reconfiguration proposed by Teece (2012).

This study has six sections. "Theoretical framework" presents the theoretical framework for competitive and innovation strategies, dynamic capabilities, and the primary characteristics of STBFs. "Research method" discusses the study's research method. "Results of the quantitative phase" presents the results of the survey and case studies. "Discussion of the results" presents the results. "Conclusions" presents the conclusions.

Theoretical framework

This study's theoretical framework is based on contributions from the literature on innovation strategies, dynamic capabilities, and STBFs.

Innovation strategy

Technological and social changes that began in the twentieth century changed socioeconomic relationships and marked the rise of technologies in different sectors and economic segments. This has compelled companies to prepare to exploit opportunities and mitigate threats in the market (Lukovszki et al. 2020). Given the introduction of recent technologies, competitive advantages can be related to technological improvements, the development of strategic partnerships, and innovations at the expense of traditional factors, such as production flexibility, delivery speed, and production costs (Dobni and Sand 2018).

Although innovation and technological improvements, such as the sources of competitive differentiation, were mentioned by Adam Smith in "The Wealth of Nations," Karl Marx in "Capital," and Alfred Marshall in "The Principles of Economy," the meaning of variables of economic development was only consolidated in 1912, with Joseph Schumpeter's "The Theory of Economic Development" (Lukovszki et al. 2020). Schumpeter's (1997) economic theory differentiates inventions from innovations. Whereas an invention involves creating new products without providing necessary or immediate financial gains, innovation encompasses the financial gains from the sale of inventions (Schumpeter 1997). Hsiao and Hsu (2018) defined innovation as the use of existing or new external or internal technologies, resulting in the developing of new processes or products.

Innovation facilitates enterprises' resource management while helping create new capabilities, ensuring penetration into new markets and competitive advantages (Turulja and Bajgoric 2019; Verreynne et al. 2019). However, for innovation to be practical, enterprises must adapt to external environmental changes by adopting strategies that stimulate and explore the innovation process (Dobni and Sand 2018). Competitive strategies can be sources of competitive advantage in sectors characterized by significant levels of dynamism and uncertainty (Sheng 2017).

The integration of strategy and innovation, forming an innovation strategy, enables enterprises to innovate and survive (Dobni and Sand 2018; Sheng 2017). In summary, innovation strategy refers to the set of decisions enterprises make to establish objects, allocate resources, and innovate by considering external and internal changes (Sheng 2017).

Dynamic capabilities

Enterprises use organizational resources to devise activities, formulate strategies, develop dynamic capabilities, and achieve competitive advantages (Bygdalle et al. 2023; De Massis et al. 2018; Sheng 2017). There are two types of organizational resources: tangible resources for easy visualization and evaluation. The second comprises the intangible resources of complex visualization and evaluation, which are usually embedded in organizational history and culture (Crescimanno et al. 2023; De Massis et al. 2018; Sok et al. 2016).

Carvalho et al. (2014) and Crescimanno et al. (2023) extended the explanations of organizational resources and showed that tangible resources are divided into physical resources (raw materials, distribution channels, machines/equipment, and stocks) and intangible resources, which are further divided into financial resources (the capacity to generate income and cost control), organizational resources (organizational culture, formal structure, flexibility for change, information technology (IT), planning, control, and coordination of processes, routines, and quality), technological resources (copyrights, patents, trademarks, trade secrets, and R&D investments), human resources (human capital, competence, tacit knowledge, trust, managerial style, incentives, freedom of expression, and training), and reputational resources (brand and relationship with customers and suppliers).

For example, reconfiguring organizational resources is essential in dynamic environments where advantages and competitive positions can be temporary (Adam et al. 2018; Aramand and Valliere 2012; Jantunen et al. 2005). Additionally, firms operating in these environments experience rapid technological obsolescence, changes in competitors' positions, and modifications in customers' needs, forcing managers to invest constantly in R&D (Adam et al. 2018; Forés et al. 2023; Haapanen et al. 2018). The possibility of reconfiguring resources and capabilities in response to fluctuating external demands and forming dynamic capabilities facilitates the development of competitive and innovative strategies to help enterprises overcome their constraints and gain competitive advantages (Haapanen et al. 2018; Jantunen et al. 2005; Jeng and Pak 2016; Sok et al. 2016).

The dynamic capabilities approach analyzes competitive processes that can trigger changes in organizational performance by considering how companies develop and maintain resources, particularly in dynamic environments (Aramand and Valliere 2012; Jantunen et al. 2005; Schoemaker et al. 2018). Dynamic capabilities originate from organizational processes comprising organizational structures, systems, and cultures applied to sense, seize, and reconfigure resources and competencies as external demands fluctuate (Forés et al. 2023; Schoemaker et al. 2018). Therefore, dynamic capabilities form the basis on which companies respond to external changes and attain new kinds of competitive advantages, with their origins in the characteristics of or changes in the external environment (Aramand and Valliere 2012; Mousavi and Bossink 2018).

With increasing competition, strategic theories have refined the original concept of dynamic capabilities, indicating that companies can compete not only to explore and develop untapped resources and capabilities but also to incrementally renew existing resources and capabilities (Forés et al. 2023; Schoemaker et al. 2018).

Micro-foundations form dynamic capabilities (Haapanen et al. 2018; Teece 2012, 2018). Micro-foundations refer to skills, processes, procedures, organizational structures, and decision-making rules that facilitate the development and implementation of dynamic capabilities (Haapanen et al. 2018; Teece 2012, 2018). Therefore, identifying and disaggregating dynamic capabilities and considering their micro-foundations can enable companies to better adapt to new external demands, assist in the effective development of innovation strategies, and allocate organizational resources (Haapanen et al. 2018; Teece 2012, 2018).

This study considers the micro-foundations of sensing, seizing, and reconfiguration, as proposed by Teece (2012, 2018). The sensing micro-foundation identifies and evaluates market and technological opportunities by acquiring new knowledge and monitoring the external and internal environments. The seizing micro-foundation refers to the capacity to capture and seize external opportunities. The reconfiguration micro-foundation describes the continuous renewal of organizational resources to obtain a competitive advantage (Adam et al. 2018; Schoemaker et al. 2018).

Additionally, we consider the dimensions that form the micro-foundations, as proposed by Adam et al. (2018), Babelytė-Labanauskė and Nedzinskas (2017), Froehlich et al. (2017), and Mousavi and Bossink (2018). According to them, the

sensing, seizing, and reconfiguring micro-foundations were decomposed into 11, 16, and seven dimensions, respectively, as indicated below.

Sensing micro-foundations: learning and training; performance evaluation; sharing ideas and suggestions for improvement; development of reliable strategic partnerships with external agents; encouraging consumers to reveal personal feelings and behaviors; exploring scientific and technological opportunities; identifying new market segments and new customer needs; incorporating knowledge acquired from customers; and empathetically observing customers and showing an understanding of their feelings, desires, and processes to direct R&D investments.

Seizing micro-foundations: complementary assets; organizational compatibility (culture, motivation, decision-making, division of labor, and conflict resolution); efficiently coordinating partnerships to obtain organizational resources; establishing and maintaining communication channels, organizational structure, and infrastructure; strategic planning; organizational processes; capability to promptly interact with the market; reducing uncertainty by transparently presenting motives, responsibilities, and benefits; routines to facilitate decision-making and encourage loyalty and employee commitment; solutions for customers and business models (target customer selection, value delivery, technology selection, customer orientation, etc.); and informal working and unbureaucratic administration.

Reconfiguration micro-foundations: knowledge acquisition through partnerships with universities and research centers, co-specialization (shared use of unique assets not easily identifiable by competitors), and customer-based learning skills.

Micro and small technology–based firms

Large companies have long been at the center of economic, political, and academic debates; however, little significance has been accorded to micro and small firms (MSFs) (Jensen and Clausen 2017). Nevertheless, for these authors, only from the early 1990s onward have the latter been incorporated as relevant objects in the discussions. These firms contribute to nations' social and economic development, and because of their specificities, require administrative theories adapted to their daily realities (Cho et al. 2017; Ko and Liu 2017; Lukovszki et al. 2020).

Among MSFs, STBFs stand out as firms that foster innovation. Although it is difficult to characterize STBFs because new technologies transcend the boundaries of traditionally divided industrial sectors, certain factors differentiate them from other MSFs (Côrtes et al. 2005). These characteristics include high R&D investments; development of R&D departments; incentives for scientific research; use of technological knowledge; development of new/improved processes, products, and services by exploring knowledge or technology; high rate of technological obsolescence; use of skilled labor; partnerships with universities; protection of organizational resources through patents and intellectual protection; and high international competition and use of IT (De Oliveira and Terence 2018; Jensen and Clausen 2017; Ko and Liu 2017). STBFs aim to explore knowledge, technology, or the results of scientific research by combining capabilities, innovation strategies, and more systematic innovative planning (Jensen and Clausen 2017; Ko and Liu 2017).

Table 1 Differences between MSFs and micro and small technology–based firms

	Micro and small firms	Micro and small technology–based firms
Goals and strategies	Gaining profits	Return of expenses in an extremely short period because of dynamic changes in technology
	Often passive or reactive strategy versus changes in environment	Proactive, anticipating changes in environment, especially opportunities and chances
	The lack or rarity of cooperation with other organizations, focus on producing material goods	Intense, strategic, domestic, and international cooperation, especially with R&D centers
	Building competitive advantage on the basis of capital and financial assets	Building competitive advantage on the basis of knowledge, intellectual capital, and innovations
	Investing mainly in tangible assets	Investing in tangible and intangible assets with high-risk factor
Production and technology	Mass and large series production of goods for mass consumers, long production batches, few patents, and rare inventions	Production of goods involving resources of modern science and technology for an intelligent customer, short production batches, numerous patents and licenses, and continuous innovation
	Large capital demand	Large scientific input demand
	Specialized plants	Variable processes plants
	Long changeover time of machines and technical equipment	High level of rotation of technical equipment; replacing with more modern and innovative devices
	Limited integration of production process (focus on partial processes)	High integration of production process (focus on making an innovative product)
People	High employment of production personnel	High employment of science and technical personnel as well as persons with knowledge
	Individual work or in permanently organized teams	Team work with significant mobility and diversity as well as temporary participation
	Low creativity of personnel and heteronomy and frequent lack of independence in problem solving	High creativity of personnel, creative thinking and autonomy, and independent problem solving
	Little training and skills improvement	Continuous training for improvement of qualification and development of personnel and team learning
	Disciplinary measures for mistakes	Learning from mistakes

Table 1 (continued)

	Micro and small firms	Micro and small technology–based firms
Organizational structure	Traditional, focused on the functions of a company	Cooperation networks of self-managing entities, focused on processes
	Hierarchy, monolithic, and developed	Weaker hierarchy links, domination of horizontal connections with virtual features
	Fixed and structured organization	High dynamics of change and flexible organization
	High centralization	High decentralization
	Formalized, mainly vertical communication	Communication via advanced information technologies, vertical and horizontal, often informal
Management	"Control-focused" management	"Support-focused" management
	Practicing stereotypes	Negating stereotypes
	Making decisions frequently on the basis of intuition or within fixed procedures	Making decisions on the basis of empirical data
	High position of managers	Significant autonomy of employees, based on competences
	Avoiding uncertainty	Acceptance of uncertainty and permanent change

Source: Adapted from Gray and Mabey (2005), Lussier and Sonfield (2015), Pett et al. (2012), and Zakrzewska-Bielawska (2010)

The main differences between MSFs and STBFs are presented in Table 1.

How STBFs are founded can influence their performance and development, with STBFs usually created from the knowledge and experience accumulated by managers, market opportunities, or partnerships with universities and research centers (Adam et al. 2018).

In one of the first publications on STBFs in Brazil, Marcovitch et al. (1986) defined them as high-tech companies founded to produce products/services with high technological content. Ferro and Torkomian (1988) indicated that such firms possess rare and exclusive competencies and use a high degree of technical knowledge.

According to Côrtes et al. (2005), STBFs develop technologies for manufacturing new products. However, this definition distinguishes STBFs from firms that only modernize their productive and technological processes and whose operations focus on manufacturing products that already exist in the market.

Dynamic capabilities in micro and small technology–based firms

Organizational resources form the basis for developing strategic activities that generate innovative results and promote sustainable growth (Pan et al. 2018). However, as MPEBTs do not individually possess all the resources and capabilities required to innovate, strategic partners such as customers, suppliers, rivals, universities, research centers, government departments, and financial institutions can help these firms overcome resource constraints and assist in detecting external environmental opportunities (Adam et al. 2018; De Oliveira and Terence 2018)

The possibility of reconfiguring resources and capabilities as external environmental demands change leads to dynamic capabilities, and their micro-foundations enable STBFs to overcome their constraints and effectively develop innovation strategies (Haapanen et al. 2018). According to the process of forming dynamic capabilities in STBFs, micro-foundations provide task structures and skills to facilitate the understanding and management of different organizational activities. Therefore, STBFs use dynamic capabilities to partially compensate for a lack of organizational resources (Adam et al. 2018; Haapanen et al. 2018).

Regarding the contribution of micro-foundations in compensating for the lack of resources, Haapanen et al. (2018) stated that allocating resources for promoting micro-foundations facilitate the development of dynamic capabilities with greater effectiveness, which contributes to competitive advantage. However, competitive advantage may not be the result of resource allocation and capabilities among micro-foundations but rather of the manner in which resources and capabilities are used to detect opportunities and threats.

Research method

This study is exploratory. A mixed research method was developed to achieve the proposed objective based on a survey conducted between May and June 2019 with a sample of 104 STBFs from São Paulo. The second qualitative phase was based on

case studies, and information was collected through five semi-structured interviews with STBF managers between November and December 2019.

This study analyzed strategic behavior using variables such as the definition and formalization of competitive and innovation strategies, R&D investments, development of R&D departments, variables that constitute the external environment, innovation-oriented organizational resources, and development of dynamic capabilities. As these variables were compiled from the literature on strategies developed for large companies, the case studies illustrate the significance and impact of each variable that constitutes strategic behavior in the daily executive actions of STBFs.

Sample selection for the quantitative phase

The sample analyzed in this study comprised 104 STBFs who completed a survey questionnaire. The decision to study firms from São Paulo is justified because this state has social characteristics favorable for innovation, such as contributing 31% of the national GDP; housing 25% of the country's universities; and hosting 50 business incubators, 28 technology parks, several innovation promotion agencies, and the Desenvolve São Paulo Bank, which facilitates the creation and development of STBFs (Ambiente de inovação brasileira 2019).

Initially, information was obtained from organizations specialized in the dissemination of technoscientific knowledge, such as the National Association for Research and Development of Innovative Companies (ANPEI), innovation agencies of the Federal University of São Carlos (UFSCar), the University of São Paulo, the Brazilian Institute of Geography and Statistics (IBGE), and the Brazilian Service of Support for Micro and Small Enterprises (SEBRAE). As a state registry of STBFs was not found, indirect searches focused on STBFs registered at incubator sites and technology parks. The agencies chosen for this study were the National Association of Promoters of Innovative Enterprises (ANPROTEC) and INVESTSP sites. Additional searches were conducted on the website of the São Paulo State Board of Trade (JUCESP).

The main limitation of the quantitative phase was the difficulty in obtaining cadastral information on STBFs in São Paulo. The absence of a cadastral state registry and the use of indirect databases to obtain cadastral information on this type of firm may indicate that the sample used in this study is not representative. Thus, the results may not represent the strategic behavior of STBFs in São Paulo.

The search identified 589 companies, and questionnaires were e-mailed to them. Of these, 62 had information-related errors, and the managers did not return 423. Thus, 104 companies (17.65% of the total sample) completed the questionnaires correctly, and the results were considered valid and used in the data analysis.

Characterization of the quantitative phase sample

These 104 companies were founded in three ways, as shown in Table 2.

Table 2 Distribution of STBFTs based on the mode of foundation

Mode of foundation	Frequency	Percentage
Based on the knowledge and experience accumulated by the managers	46	44.34%
Based on business opportunity	35	33.96%
Based on research conducted in universities	22	20.75%
Another form of foundation	1	0.94%

Source — Own elaboration

In addition to the classification based on the foundation mode, this study identified the main sectors in which STBFs operate. The information in Table 3 is based on the IBGE (2010) classification of economic sectors.

These 104 firms operate in sectors related to industry (IND), commerce, and services (CSE). Of these, 40 firms operate in the industrial sector, and 64 technology-based firms operate in the commercial and service sectors. After presenting and characterizing the sample obtained for the survey, we explained the choices of the five companies investigated in the qualitative phase.

Sample selection for the qualitative phase

The responses obtained from the 104 STBFs were subjected to cluster analysis to identify the similarities and differences between the investigated firms. The results of the cluster analysis are shown in Fig. 1.

Cluster 1, with 48 STBFs, comprised firms with higher values for the percentage of the variable invested in R&D, the allocation of organizational resources to innovation, and external environment variables. Cluster 2 included 31 STBFs with higher values for number of employees, annual turnover, and the launch and improvement of products, processes, and services. We also identified cluster 3, which comprised 25 STBFs with lower values for the percentages of the variables of R&D investments, allocation of organizational resources to innovate, and the external environment; cluster 3 was discarded. Only two firms operate in the industrial sector, which was one of the criteria adopted in this study to choose the cases. Including firms in the service sector implies an expansion of the variability factors. Moreover, comparing cases is difficult because of the significant differences between the activities performed in the industrial and service sectors.

Company size was evaluated based on a classification according to the number of employees. The questionnaire items were rated on an 8-point Likert scale ranging from 1 to 7, with 1 representing unimportant and 7 representing important.

The five STBFs selected for the case studies had the following characteristics: STBFs A and B, belonging to cluster 1, invested more than 20% of their budget in R&D; allocated resources to innovate; considered most of these resources as necessary (values 5, 6, and 7 from the Likert scale); defined competitive and innovation strategies; and innovated, with launches and improvements in processes, products, and services in classes 1–2 and 3–5 innovations. STBF C, also from cluster 1,

Table 3 Sectors in which the investigated STBFs operate

Sector of operation	Frequency	Percentage
1 Computer equipment and electronic and optical products	**53**	**50.96%**
1.1 Industrial automation and precision	*9*	8.65%
1.2 Electronic equipment	*3*	2.88%
1.3 Communication equipment	*4*	3.85%
1.4 Computer	*4*	3.85%
1.5 Information technology	*31*	29.81%
1.6 Livestock tracking and identification	*1*	0.96%
1.7 Additive manufacturing	*1*	0.96%
2 Food products	**1**	**0.96%**
2.1 Encapsulated foods	*1*	0.96%
3 Pharmochemical products	**16**	**15.38%**
3.1 Biotechnology	*13*	12.50%
3.2 Cosmetics	*3*	2.88%
4 Chemical products	**1**	**0.96%**
4.1 Electrolysis, electrolyzers, and hydrogen production	1	0.96%
5 Medicines for human use	**10**	**9.62%**
5.1 Medical-hospital equipment	*10*	9.62%
6 Aerospace vehicles	**4**	**3.85%**
6.1 Avionics	*3*	2.88%
6.2 Aerospace vehicles	*1*	0.96%
7 Machines and equipment for basic sanitation and environment	**4**	**3.85%**
7.1 Solid waste treatment and disposal	4	3.85%
8 Software development	**15**	**9.62%**
8.1 Dating applications	3	2.88%
8.2 Software development	1	0.96%
8.3 Distance learning	3	2.88%
8.4 Enterprise resource planning	1	0.96%
8.5 Petroleum engineering	1	0.96%
8.6 Management of armored vehicles	1	0.96%
8.7 Data management	2	1.92%
8.8 Payment methods	1	0.96%
8.9 Corporate programs for life quality, health promotion, and ergonomics	1	0.96%
8.10 Computer simulation	1	0.96%

Source — Own elaboration

invested between 3 and 5% of its budget in R&D and allocated resources to innovate; considered most of its resources as "important" (values 5, 6, and 7 on the Likert scale); defined only competitive strategy; and innovated, with launches and improvements in processes, products, and services distributed between classes 1–2 and 3–5 innovations. STBFs D and E, in cluster 2, with more employees and higher revenues than previous firms, allocated resources to innovate but did not indicate that most

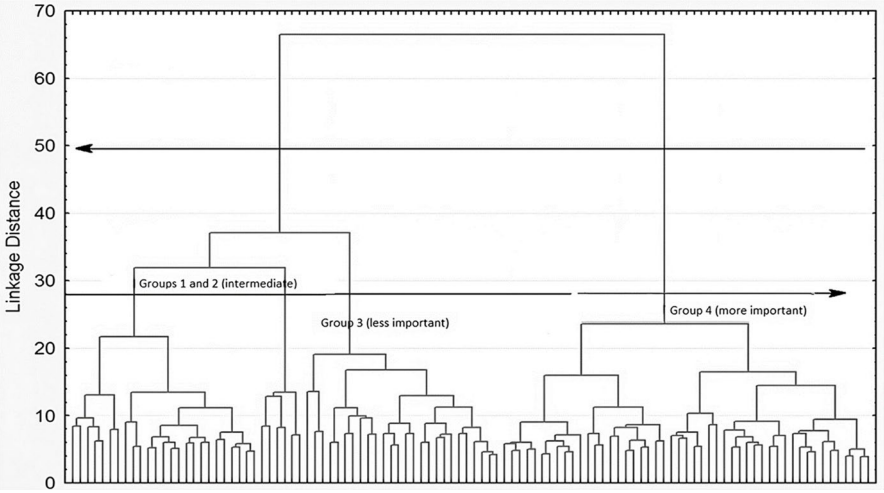

Fig. 1 Dendrogram illustrating the hierarchical grouping of data, where the lines represent the completed questionnaires and the columns represent survey questions. Source: Own elaboration

organizational resources were essential to innovate (values 5, 6, and 7 on the Likert scale). Additionally, these firms defined competitive and innovation strategies and made significant innovations, indicating values greater than 18 for product launches and improvements.

The five interviews were recorded and transcribed separately, respecting the integrity of the speeches, and analyzed using the Content Analysis Technique (Greneheim and Lundman 2004). Using the qualitative method through semi-structured interviews and the content analysis technique facilitated more detailed knowledge of themes, such as the characteristics of the sectors in which each STBF operates, organizational resources, types of innovation, and dynamic capabilities, including their micro-foundations. These micro-foundations were proposed by Teece (2012, 2018).

Characterization of the qualitative phase sample

Founded in 2005, STBF A is based on the knowledge and experience accumulated by managers. The company operates in the medical-ophthalmic products sector, produces equipment for diagnosing ophthalmological diseases, and has 47 employees.

Founded in 1992, STBF B operates in the medical-ophthalmic product sector. It produces equipment for diagnosing ophthalmological diseases based on the knowledge and experience accumulated by its manager and has 16 employees.

The STBF C was founded in 2005 based on business opportunities. It operates in the manufacturing sector of devices for measurements, tests, and controls; performs livestock tracking and identification for cattle, goats, and buffaloes; and has six employees.

STBF D was founded in 2006, based on business opportunities. It operates in the electronic document and process management sectors and has 21 employees.

Finally, STBF E, founded in 2005, is based on manager knowledge and experience. The company operates in the industrial automation sector, produces on-demand client electronic boards for industrial automation, and has 40 employees.

Results of the quantitative phase

The quantitative data analysis began by identifying the variables that constitute the external environment of the investigated STBFs. Table 4 presents the means and standard errors of the values managers attribute to the variables listed in the questionnaire. A Likert scale was used for each variable, with values between 1 and 7, where 1 implied unimportant and 7 represented totally important.

Pearson's correlations calculated among the external environmental variables are presented in the Appendix. Three correlations were considered high. The first ($r = 0.57$) was between "environmental dynamism" and "environmental uncertainty." The second ($r = 0.47$) was between "Need for innovation" and "Technological obsolescence"; the third ($r = 0.51$) was "Need for innovation" with "Market opportunities."

Strategic behavior in technology-based firms

Managers were asked whether their firms have defined competitive innovation strategies. Their responses are presented in Table 5.

For the competitive strategy, the percentage value obtained (87.50%) for the "yes" variable was significantly higher than 50% ($p < 0.01$). For innovation strategy, the percentage value of the yes variable (63.46%) was also statistically higher than 50% ($p < 0.006$).

Dobni and Sand (2018) and Sheng (2017) indicated that STBF managers define competitive and innovative strategies. Furthermore, they showed that managers

Table 4 Means of the external environment variables

Variables	Means	Standard errors
Partnerships with customers	6.09	0.14
Innovation need	6.07	0.12
Market opportunities	5.99	0.12
Technological obsolescence	5.13	0.16
Relationship with suppliers	5.04	0.18
Price pressure	4.51	0.18
Competitors	4.21	0.16
Environmental dynamism	4.20	0.18
Environmental uncertainty	3.43	0.17
Others	3.28	0.20

Source — Own elaboration

Table 5 Definition of competitive and innovation strategies in MSFs investigated

Defines competitive strategy	Frequency	Percentage	Defines innovation strategy	Frequency	Percentage
Yes	91	87.50%	Yes	66	63.46%
No	13	12.50%	No	38	36.54%

Source — Own elaboration

define strategies to monitor changes in the external environment and implement managerial actions to adapt to these new external conditions.

Next, we present the results for R&D investment and the development of R&D departments. The percentages of R&D investment are shown in Fig. 2.

The 0 to 2% class received the highest percentage of responses in 2015, 2016, and 2017. Additionally, the three minor classes (0 to 8%) had investments above 50% in 2015 and 2016. However, in 2017, the total number of classes had decreased to 40.56% of the total. In contrast, the most significant investment classes, represented

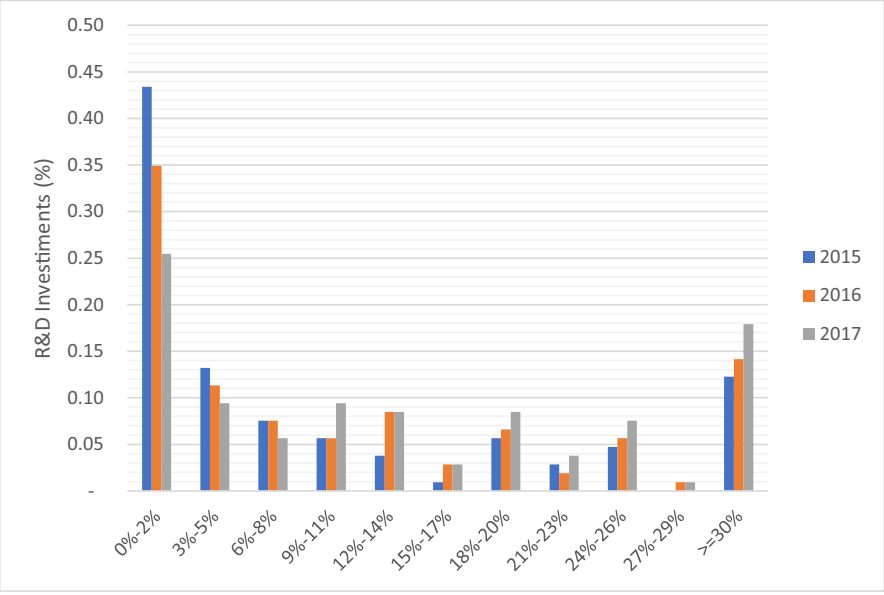

Fig. 2 R&D investments (2016–2018)

Table 6 Development of the R&D department

R&D department	Frequency	Percentage
Yes	65	62.50%
No	39	37.50%

Source — Own elaboration

by 9 to 11%, showed favorable variations. The results of the significance of developing an R&D department for innovation are presented in Table 6.

Considering the large sample, the number of managers who claimed to have R&D departments was high. After obtaining the values invested in R&D, managers answered whether their firms launched and/or improved processes, products, and services in the last 3 years. The results are summarized in Table 7.

The binomial proportions revealed that the percentage of managers who answered yes was statistically higher ($p < 0.0001$) than those in the "no" category. There may be further reflections on whether the development and maintenance of R&D departments influence the type of innovation. Initially, the influence of the R&D department on the type of innovation was investigated to identify the predominant innovation type. Consequently, of the 65 firms, 58 had launched processes, products, and services, and seven had not. Of the 65 STBFs, 60 had improved their processes, products, and services, and five had not.

Next, we considered the possible influence of the R&D department on these two types of innovation. Of the 65 firms with R&D departments, 55 had launched and improved their processes, products, and services; however, two STBFs had not; five only improved their processes, products, and services, and three had only launched processes, products, and services.

The finding that the investigated STBFs invested in R&D and developed R&D departments corroborates the statements of De Oliveira and Terence (2018), Jensen and Clausen (2017), and Ko and Liu (2017). They showed that STBFs that invest in R&D possess a better knowledge of available technologies, which tends to favor innovation in dynamic, uncertain, and highly technologically obsolete sectors.

Finally, managers indicated their primary organizational resources to innovate and develop their dynamic capabilities. The resources are listed in Table 8, with the respective means calculated from the values indicated on an 8-point Likert scale, where 1 implies unimportant and 7 signifies important.

The most significant resources showed that the process of innovating and developing dynamic capabilities in STBFs primarily uses intangible organizational resources.

Results of the qualitative phase

The qualitative section shows how the variables constituting strategic behavior (the definition of competitive and innovation strategies, the mobilization of organizational resources, and the development of dynamic capabilities) are in the managerial reality of STBFs.

Table 7 Launch and improvement of processes, products, and services

Binary variable	Launch	Percentage	Improvement	Percentage
Yes	92	88.46%	97	93.27%
No	12	11.54%	7	6.73%

Source — Own elaboration

Table 8 Distribution of organizational resources

Organizational resources	Means
Technological knowledge	6.46
Entrepreneurship	5.76
Partnerships with customers	5.74
Information technology	5.64
Knowledge management	5.54
Financial resources	5.53
Innovation strategy	5.39
Organizational culture	5.11
Competitive strategy	5.07
Market analysis	4.85
Organizational structure	4.41
Partnerships with universities	4.35
Machines and equipment	4.16
Distribution channels	3.92
Trade secret	3.92
Patent	3.57
Access to raw materials	3.46
Trademarks	3.31
Other	2.78

Source— Own elaboration

In the quantitative stage, the evaluation of dynamic capabilities is based on the classification of the primary organizational resources used to innovate. In the qualitative stage, in addition to classifying organizational resources, the development of dynamic capabilities was evaluated by sensing, seizing, and reconfiguring microfoundations and organizational resources.

Definition of competitive and innovation strategies

STBFs A and B operate in the medical-ophthalmic product sector. Managers A and B had degrees in business and electrical engineering, respectively. This characterizes this sector as dynamic, dependent on foreign suppliers of technological inputs, and regulated and supervised by agencies such as the Brazilian Association of Technical Standards (ABNT), the National Health Surveillance Agency (ANVISA), and National Institute of Metrology, Quality, and Technology (INMETRO). Given these sectoral specificities, STBFs A and B defined competitive and innovation strategies and communicated strategic deliberations to their employees. Consequently, STBF B formalized its competitive and innovative strategies, whereas STBF A did not.

Manager C, who had a degree in mechanical engineering, defined the manufacturing sector of devices for measurements, tests, and controls as slightly dynamic, with high taxes and dependence on specific customer demands (cattle breeders).

Faced with these sectorial characteristics, manager C defined, but did not formalize, competitive and innovation strategies and communicated only deliberations on a competitive strategy to employees.

Manager D, who had a degree in business, defined the electronic document and process management sector as dynamic because of constant changes in laws regulating the management of data and information, high technological obsolescence, and competition with multinationals. Given such sectorial characteristics, STBF D defined and formalized competitive innovation strategies and communicated strategic deliberations to employees.

Manager E, who had a degree in visual arts and specialization in people management, defined the industrial automation sector as dynamic, with high technological obsolescence rates and the influence of competitors and importers. Given these sectorial characteristics, STBF E defined and formalized a competitive strategy, defined but did not formalize its innovation strategy, and communicated strategic deliberations to employees.

As STBFs operate in dynamic and uncertain sectors with high technological obsolescence, they present a strategic behavioral pattern of defining competitive and innovation strategies, formalizing only competitive strategies, and communicating strategic deliberations to employees.

Dynamic capabilities

A few organizational resources employed by STBFs A and B to meet customer demands (ophthalmologists) included government subsidies obtained through innovation promotion agencies, employee training, investments in R&D, and the maintenance of R&D departments. Additionally, clients usually acquire and demand technologically advanced products by participating in international congresses. Especially regarding knowledge acquisition and dissemination, whereas STBF A primarily used consultancy and third-party knowledge to discuss new market needs with employees, STBF B encouraged employees to directly interact with ophthalmologists and their patients by participating in awareness campaigns on chronic diseases.

STBFs A and B are the only firms that used resources from innovation promotion agencies (PIPE/FAPESP and the Desenvolve São Paulo bank) to develop innovative projects. Although Kenski and Marcondes (2017) found that innovation promotion agencies/programs, particularly PIPE/FAPESP, can help STBFs allocate organizational resources to innovate and develop dynamic capabilities, this study found that only STBFs A and B used funding from innovation promotion agencies.

The few organizational resources that STBF C employed to meet specific demands from clients (cattle breeders) included acting proactively, anticipating new market demands, participating in national and international fairs, investing in R&D, and making strategic partnerships with companies from other sectors, especially those from the IT sector.

STBF D used resources to develop and sell software for electronic document management, such as employee training, investments in R&D, maintenance of R&D departments, changes in organizational culture, and strategic partnerships with customers.

Manager E listed several resources (employee training, investing in R&D, developing R&D departments, and establishing strategic partnerships with customers and companies from other sectors) aimed at the on-demand production of boards for industrial automation. Additionally, as the firm has customers in several sectors (food, automotive, energy, hospitals, and dentistry) with diverse technological requirements, several technologies have been developed to determine each demand. Table 9 shows the organizational resources employed by STBFs for innovation.

SEBRAE Brazilian Service of Support for Micro and Small Enterprises, *STBFs* Micro and small technology–based firms

All the STBFs mentioned the resources "R&D investments," "market analysis," and "technology." However, only STBF C "R&D investments" did not include

Table 9 Main resources of the five STBFs investigated

Organizational resources	STBFs				
	A	B	C	D	E
Innovation promotion agencies	X	X			
Employee training	X	X		X	X
Consulting	X			X	X
Organizational culture				X	X
R&D department	X	X		X	X
Providers	X			X	
Organizational structure			X		
Suppliers		X			
Knowledge management	X	X			X
R&D investments	X	X	X	X	X
Logistic resources					X
Partnerships with customers		X	X	X	X
Partnerships with companies from other sectors			X		X
Partnerships with foreign companies	X				
Partnerships with universities	X				
Participation in trade fairs	X	X	X		X
Participation in conferences			X		
Market analysis	X	X	X	X	X
Financial resources	X		X		X
Sales representatives	X				
Firm reputation					X
SEBRAE			X		
Technology	X	X	X	X	X

Source: Own elaboration

structuring an R&D department. In addition to the shared resources of all STBFs, it was possible to identify resources unique to firms operating in sectors with different environmental characteristics. For example, a few organizational resources indicated in STBFs A, B, D, and E (employee training, consulting, development of R&D departments, and knowledge management) were not cited by STBF C. However, organizational resources such as organizational structure, participation in conferences, and the use of SEBRAE consulting services were cited only by STBF C.

To meet specific customer demands, STBFs allocated organizational resources to innovate, especially R&D investments, the maintenance of R&D departments, employee training, and strategic partnerships with external agents, especially with customers. These results corroborate the findings of Côrtes et al. (2005) and Jensen and Clausen (2017) that STBFs are based on different knowledge and innovative resources.

Technology-intensive sectors may be dynamic, with high technological obsolescence, and may depend on specific customer and supplier demands. These external characteristics may require STBFs to constantly modify or reconfigure their organizational resources to meet new external demands.

STBFs A and B used the knowledge of employees and external agents, especially customers (ophthalmologists), to detect external opportunities and reconfigure their organizational resources. Manager B also encouraged his employees to interact directly with ophthalmologists and their patients through awareness campaigns on chronic diseases to learn how to correct project failures and identify new product functionalities. However, for manager A, the mobilization of stretched resources could be negatively influenced by a lack of adequate human and financial resources.

Manager C used existing resources to develop new projects and reconfigure organizational resources. Consequently, the firm has already developed products for the veterinary and food sectors.

Manager D also used employee knowledge and customer demand to detect external opportunities and reconfigure organizational resources. Employee information relates to knowledge management, which seeks to transform acquired knowledge into something valuable and practical for the company. Employees must constantly learn to develop new electronic document-management platform functionalities. For example, the General Data Protection Law (LGPD) compelled national companies to adopt formal electronic document management techniques. Thus, STBF D had to adapt to the customer demands from different sectors.

Manager E indicated that to explore external opportunities, he reconfigured certain organizational resources already existing in the firm, such as financial and logistical resources and the knowledge and experiences accumulated by employees. Additionally, logistical resources contributed to the internal structuring of the firm, optimizing communication processes and systems, and providing speed and agility in strategic decision-making.

The dimensions of the sensing, seizing, and reconfiguration micro-foundations are listed in Table 10.

The variables/resources indicated by all STBFs to develop dynamic capabilities were: “developing strategic partnerships with external agents,” “being able to

Table 10 Dimension of sensing, seizing, and reconfiguration micro-foundations

	Dimension of micro-foundations	STBF				
		A	B	C	D	E
Dimensions of sensing micro-foundation	Learning and training	X	X		X	X
	Sharing ideas and suggestions for improvement		X		X	
	Knowledge and experience accumulated by the managers			X		X
	Developing reliable strategic partnerships with external agents	X	X	X		X
	Exploring scientific and technological opportunities					X
	Identifying new market sectors and new customer needs	X			X	X
	Incorporating knowledge obtained from customers		X		X	X
	Empathetically observing clients to understand specific feelings, daily practices, desires, and lifestyles		X			X
	Understanding processes of direct investments in R&D	X			X	

Table 10 (continued)

	Dimension of micro-foundations	STBF				
		A	B	C	D	E
Dimensions of seizing micro-foundation	Being capable of interacting with the market	X	X	X	X	X
	Having organizational compatibility (culture, motivation, decision making, form and division of labor, and conflict resolution)		X			X
	Understanding consumption habits and the main barriers to adopting innovative solutions		X		X	X
	Coordinating partnerships to obtain organizational resources	X	X	X	X	X
	Establishing and maintaining communication channels	X				X
	Having organizational structure and infrastructure			X	X	X
	Planning strategically	X	X			
	Following organizational process					X
	Possessing financial and human resources	X			X	
	Reducing uncertainty by transparently presenting the reasons, responsibilities, and benefits		X			X
	Having informal work relations and non-bureaucratic administration			X		X
	Having routines to facilitate decision-making and encouraging employees' loyalty and commitment					X
	Creating solutions for customers and business models (target customer selection, value delivery, technology selection, customer orientation, etc.)		X	X	X	X

Table 10 (continued)

	Dimension of micro-foundations	STBF				
		A	B	C	D	E
Dimensions of reconfiguration micro-foundation	Acquiring new knowledge from partnerships with universities	X				
	Learning effectively based on external partnerships and information sharing	X		X		
	Learning effectively based on the costumers		X	X	X	X
	Configuring resources (technological assets)	X	X		X	X
	Accumulating managers' knowledge and experience			X		X
	Decentralization: delegating tasks to third parties so that the company can focus on its core competencies		X			X
	Knowledge management: integrating knowledge and learning processes and forming strategic partnerships to facilitate technology transfer and intellectual property	X	X		X	X
	Being able to change organizational routines					X
	Maintaining hierarchical flexibility			X		X
	Having financial and human resources	X			X	

Source — Own elaboration

STBFs micro and small technology–based firms

interact with the market," "coordinating strategic partnerships to obtain organizational resources," and "learning effectively based on costumers."

In addition to the variables/resources cited by all STBFs, we analyzed variables exclusive to STBFs that operate in sectors with different environmental characteristics. For example, although STBF C senses dynamic capabilities, seizes external opportunities, and reconfigures organizational resources to take advantage of them, the firm developed these capabilities using variables indicated by other MPEBTs.

In contrast, variables such as "employee training," "understanding consumption habits," "main barriers to adopting innovative solutions," "configuration of technological assets," and "knowledge management" were not identified in STBF C. They were cited exclusively by STBFs operating in sectors with higher levels of dynamism, uncertainty, and technological obsolescence.

Discussion of the results

The STBFs included in the study sample operate in several economic sectors, such as medical-ophthalmic products; manufacturing of devices for measurements, tests, and controls; industrial automation; biotechnology; and software development, with different technological demands and levels of dynamism and environmental uncertainty. Such firms exhibit strategic behavior based on the formulation of competitive and innovation strategies, allocation of different organizational resources for innovation, development of dynamic capabilities, R&D investments, structuring of R&D departments, mode of foundation, time spent in the market, organizational structure, and knowledge management.

Strategic behavior explains how STBFs survive and obtain competitive advantage in their sectors by adapting their organizational specificities (defining and formalizing competitive and innovation strategies, allocating resources, and developing dynamic capabilities) to the characteristics of each sector. This study used the results of Haapanen et al. (2018), Jeng and Pak (2016), and Sok et al. (2016), showing that strategic actions may enable STBFs to overcome their constraints and obtain competitive advantages.

For example, the case studies showed that STBFs A, B, D, and E, which operate in sectors characterized by higher levels of dynamism, uncertainty, and technological obsolescence and customers who demand technologically advanced products, are defined as competitive. Innovation strategies formalized their competitive strategies and communicated strategic deliberations to employees. In contrast, STBF C, which operates in a sector with lower levels of dynamism, uncertainty, and technological obsolescence and customers who demand products with more traditional technologies, defined, but did not formalize, competitive and innovation strategies and communicated only deliberations on competitive strategies to employees.

The quantitative phase showed that external variables such as dynamism, uncertainty, technological obsolescence, competition, and dependency on specific customer demands characterize each sector, explain how STBFs define and formalize competitive and innovation strategies, and develop dynamic capabilities.

Additionally, the qualitative phase indicated that the environmental characteristics of each primary customer's operational sector influenced the firms' strategic behavior.

To deal with distinct levels of dynamism, uncertainty, and technological obsolescence, STBFs in the quantitative phase innovated using organizational resources such as R&D investments, recent technologies, market analysis, development of strategic partnerships with customers, and participation in trade fairs. This is consistent with the findings of Adam et al. (2018) and Jensen and Clausen (2017).

The qualitative phase also indicated that the development of dynamic capabilities influences the strategic behavior of STBFs because, as external demand fluctuates, these companies must sense external changes to seize and reconfigure organizational resources. The main micro-foundations used by these firms to sense, seize, and reconfigure organizational resources to innovate include learning and training of employees, being capable of interacting with the market, learning effectively based on customers, developing strategic partnerships with external agents, and knowledge management.

Strategic partnerships with external agents, especially customers, and strategic information sharing can enable STBFs to overcome the constraints of organizational resources inherent in their size, thereby facilitating the detection of external environmental opportunities to innovate. These results are consistent with those reported by Adam et al. (2018), Haapanen et al. (2018), Kenski and Marcondes (2017), and Pan et al. (2018).

In the quantitative phase, the strategic behavior variables included the foundation mode, definition, formalization of competitive and innovation strategies, and allocation of organizational resources to innovate, as Adam et al. (2018) indicated. These differences can be explained, as indicated by Haapanen et al. (2018) and Turulja and Bajgoric (2019), by external variables (dynamism, uncertainty, and technological obsolescence) and internal resources (knowledge management, learning, employee training, R&D investments, and maintenance of R&D departments). These characteristics and the resources allocated to each firm compel STBFs to seek ways to interact with external variables, define competitive and innovation strategies, communicate strategic deliberations to employees, and allocate innovation resources.

For example, the higher proportion of resources allocated by STBF E to innovation was a response to the characteristics of the industrial automation sector. As this sector is dynamic, with high technological obsolescence, and offers products to several sectors (with different technological needs), companies in this sector must constantly use resources to sense external opportunities and seize and reconfigure resources to meet customers' new technological demands. In an environment where competitive advantages may be temporary, adapting organizational resources becomes a factor in competitive advantage for STBFs, as indicated by Adam et al. (2018).

In contrast, the smaller proportion of resources allocated by STBF C for innovation can be explained by the characteristics of the operational sector of its customers (cattle breeders). As this sector is less dynamic and has a lower level of technological obsolescence, cattle breeders demand products from manufacturers with traditional productive attributes, such as reliability, delivery time, and price, instead of adding value to their products using modern technologies.

The indication that the mode of foundation in STBFs, especially from the knowledge and experience accumulated by managers and business opportunities, can

influence the strategic behavior of these companies approximates the results of Adam et al. (2018), indicating that the mode of foundation can influence the performance and development of STBFs.

According to Adam et al. (2018) and Jensen and Clausen (2017), this study showed that innovation might depend on resources such as the knowledge and experience accumulated by managers and employees, the development of competitive and innovative strategies, strategic partnerships with external agents (especially customers), R&D investments, and the capability to interact with the market.

Conclusions

This study aimed to identify the main components of STBF strategic behavior in the state of São Paulo. Changes in technology and customer requirements have led to increased uncertainty, dynamism, and technological obsolescence in various businesses. To survive in these sectors, companies must identify opportunities and threats based on an analysis of environmental variables. However, an external analysis should be accompanied by an analysis of the internal resources of each firm.

The need to ascertain external and internal variables produces the concept of strategic behavior, which enables companies to understand these variables and adopt competitive and innovative strategies to obtain competitive advantages. In the case of STBFs, which operate in sectors impacted by dynamism, uncertainty, and technological obsolescence, and where customers need to change rapidly, strategic behavior guarantees long-term survival and strategic differentiation.

In STBFs, internal environmental variables can be analyzed using the theory of dynamic capabilities. For example, when an STBF detects new external demands, the theory of dynamic capabilities helps the firm seize and mobilize organizational resources to exploit such external demands, thereby gaining a competitive advantage over its rivals. Therefore, this study analyzed strategic behavior using external and internal variables with an emphasis on the theory of dynamic capabilities and the micro-foundations of sensing, seizing, and reconfiguration.

The strategic behavior results showed that the investigated STBFs operate in sectors with different levels of dynamism, uncertainty, and technological obsolescence. Therefore, companies allocate different proportions of their internal resources to meet different sectoral requirements.

Organizational resources, when used by STBFs operating in sectors with high levels of dynamism, uncertainty, and technological obsolescence, and constant changes in customer demand patterns tend to be reconfigured more frequently to ensure survival and obtain competitive advantages compared with STBFs operating in sectors with lower levels of dynamism, uncertainty, and technological obsolescence. Additionally, dynamic capabilities can facilitate the reconfiguration of organizational resources.

Strategic behavior in STBFs is conditioned by the characteristics/variables of the external and internal organizational environments. This study evaluated the external environment using variables that characterize firms' sectors, such as environmental dynamism, technological obsolescence, government regulations, and strategic

partnerships. The case studies showed that STBFs operating in less dynamic sectors and with lower technological levels allocate fewer organizational resources, develop fewer dynamic capabilities, and tend not to formalize strategies compared with STBFs operating in more dynamic and technologically advanced sectors.

Regarding the internal environment, STBFs that employ the knowledge and experience accumulated by managers, invest in employee training and knowledge management, and develop an appropriate organizational culture have more favorable conditions for acquiring dynamic capabilities.

This study found that the strategic behavior of STBFs in São Paulo can be initially described by the definitions of competitive and innovation strategies and the formalization of the competitive strategy. Thereafter, the allocation of organizational resources for innovation and the development of dynamic capabilities were identified by factors/resources such as knowledge and experiences accumulated by managers and employees, development of competitive and innovation strategies, strategic partnerships with external agents (especially customers), R&D investments, development and maintenance of R&D departments, and the capability to interact with the market. Finally, sectoral characteristics can influence strategic behavior, especially dynamism, uncertainty, and technological obsolescence.

Future research should investigate the influence of dynamic capabilities on the innovation process because they help companies operating in uncertain and dynamic sectors sense external opportunities and seize and reconfigure organizational resources to exploit external opportunities to obtain competitive advantages. Table 11

Appendix

Table 11 Pearson's correlation for external environment variables

	2	3	4	5	6	7	8	9	10
1	0.22	**0.15**	0.32	**0.10**	0.26	**0.17**	0.27	0.26	**0.16**
2		**0.11**	**0.17**	0.28	**0.13**	**0.07**	**0.17**	0.45	**0.15**
3			0.33	0.57	0.20	**0.10**	0.30	0.32	**0.11**
4				0.32	0.26	**0.15**	0.30	0.29	**0.14**
5					0.13	0.18	**0.16**	0.40	**0.13**
6						0.47	0.51	**0.04**	**0.11**
7							0.28	**0.11**	**0.02**
8								**0.15**	**0.00**
9									**0.08**

The coefficients in bold show that the correlations are not significant ($p > 0.05$). 1 Partnerships with customers; 2 Competitors; 3 Environmental dynamism; 4 Relationship with suppliers; 5 Environmental uncertainty; 6 Innovation need; 7 Technological obsolescence; 8 Market opportunities;

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