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Innovation as an internationalisation determinant of Brazilian technology-based SMEs

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Abstract

The general objective of this article is to analyse innovation as a determinant of the internationalisation patterns of Brazilian technology-based SMEs (small and medium enterprises) in different sectors and with different technological features. The theoretical background of this article centres on the typologies of innovation, SMEs' internationalisation patterns, and innovation as an internationalisation determinant. The main theoretical contributions of this qualitative study are its analysis of innovation of the firm, focusing on the type of innovation, the degree of novelty, and the degree of control over the innovation process as determinants of their internationalisation patterns, and the influence of the external organisational environment on innovation and internationalisation. In terms of managerial implications, we highlight the effect of these factors on the competitiveness of case firms in international markets. Finally, our suggestions for future studies include the need for research replication in other emerging markets, the inclusion of both mature and young technology-based SMEs in the sample, the use of longitudinal data for case studies, and the validation of this qualitative study through a quantitative study that includes a larger sample of technology-based SMEs.

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Resumen
El objetivo general de este artículo es analizar la innovación como determinante de los modelos de internacionalización de las PYME (pequeñas y medianas empresas) brasileñas de base tecnológica en diferentes sectores y con diferentes características tecnológicas. El marco teórico de este artículo se centra en las tipologías de innovación, los modelos de internacionalización de las PYMES y la innovación como determinante de la internacionalización. Las principales contribuciones teóricas de este estudio cualitativo son su análisis de la innovación de la firma, que se centra en el tipo de innovación, el grado de novedad y el grado de control sobre e l proceso de innovación como determinantes de los modelos de internacionalización, y la influencia del entorno organizacional externo en innovación y internacionalización. En términos de implicaciones gerenciales, destacamos el efecto de estos factores en la competitividad de las firmas de casos en los mercados internacionales. Finalmente, nuestras sugerencias para estudios futuros incluyen la necesidad de replicar la investigación en otros mercados emergentes; la inclusión en la muestra de PYMES de base tecnológica tanto maduras como jóvenes; el uso de datos longitudinales para estudios de casos; y la validación de este estudio cualitativo a través de un estudio cuantitativo que incluya una muestra más amplia de PYMES de base tecnológica.

Keywords Innovation · Internationalisation · Small Businesses · Developing Nations

Palabras llave Innovación · Internacionalización · Pequeños Negocios · Naciones en Desarrollo

JEL Classification F23 · N56 · N66 · N76 · O32 · O33

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Summary highlights

Contributions of the Paper: The main contributions of this paper are twofold: an intrafirm analysis of innovation, which focuses on case firms' type, degree of novelty, and degree of control over the innovation process as determinants of their internationalisation patterns, and an analysis of the influence of the external organisational environment on innovation and internationalisation.

Research Questions/Purpose: The research question of this paper is as follows: how do Brazilian technology-based SMEs innovate, and how do the innovation outputs determine internationalisation?

Methodology: The empirical study conducted by this paper has the following phases: first, the research design phase, which presents the database selection and data processing. The next phase is the selection of case firms based on eligibility criteria. The sample is composed of six case firms that agreed to participate in the case study. The last phase, that of research data analysis, consists of descriptive data analysis (within-case analysis) and comparative data analysis (cross-case analysis).

Database/Information: The Brazilian Ministry of Economy provides the main online public databases of exporting firms based in Brazil used in this research. The current version of the online public database "List of Brazilian Exporting and Importing Companies" contains fundamental data related to exporting firms based in Brazil. This database is updated annually, and a full version of this list is available online at the beginning of the subsequent year. This database is also partially updated during the current year.

Results/Findings: The first finding of this paper is the prevalence of incremental innovation development in products (goods), which was found in case firms A, B, D, and E, that of innovation development in products (goods), regardless of their novelty degree, which was found in case firm F, and that of radical innovation development in marketing, which was found in case firm C, as determinants of the internationalisation patterns of Brazilian technology-based SMEs in different sectors and with different technological features. The second finding of this paper is the significant interference of the Brazilian external organisational environment on both innovation and internationalisation processes, which is considered to be a key negative determinant.

Limitations (If Any): The limitations of this paper are twofold. The first limitation concerns the restriction of the data used to the available version of the online public database, which presents other data than it contained during the entire period of the empirical study, which took place from September 2014 to December 2015. The second limitation concerns the retrospective nature of the questions of the interview guide pertaining to innovation and internationalisation.

Suggestions for Further Research: There are four suggestions for further research. This study can be replicated in the context of other emerging countries, as the understanding of innovation as an internationalisation determinant of technology-based SMEs developed in this context enables a macro comparative data analysis. There is also the possibility of replicating this research by including both mature and young technology-based SMEs in the sample. Future research may employ longitudinal data concerning case studies instead of data from specific time points to broaden the period of observation of the innovation and internationalisation processes. The last proposal for future research is the validation of this qualitative study through a quantitative study encompassing a larger sample of technology-based SMEs.

Managerial/Theoretical Implications and Recommendations for Further Research: The managerial and theoretical implications and recommendations for further research of this paper include an intrafirm analysis of technological and non-technological innovation development, which can describe how this process occurs in case firms and how the innovation outputs determine internationalisation.

Practical Implications and Recommendations: The practical implications and recommendations of this paper are directed to managers and practitioners who must bear in mind the effect of the external organisational environment, i.e. the Brazilian context, on the strategic planning of the firm, as it exerts influence on both innovation and internationalisation processes.

Public Policy Recommendations: The public policy recommendations of this paper are directed to public managers who must pay close attention to the negative factors that are present in the Brazilian external organisational environment that can

undermine the innovation and the internationalisation processes of case firms and who must establish concrete legal solutions to solve the complexity of the legal and tax systems, which generates extra costs to firms, thus decreasing their competitiveness in national and international markets. The last public policy recommendation is the possibility of a continuing government project that aims to concretely promote economic growth through entrepreneurship, labour generation, productivity, and income improvement.

Introduction

Crescent liberalisation, globalisation, and technological advancements have given rise to new challenges and business opportunities for SMEs worldwide, which are directly responsible for contributing to employment generation, regional development, gross national product, and technological innovations in developed and developing economies. To survive and adapt their competitive strategies to changing market conditions and to sustain their competences, SMEs have to improve productivity, produce innovations, and upgrade technology to achieve technology accumulation, thus leading to an outward orientation in production and the improvement of tacit knowledge and collective efficiency (Thomas et al. 2012, p. 409–410).

Innovation is a relevant source of competitive advantages and productivity improvement in both SMEs and MNEs (multinational enterprises) with respect to the outward internationalisation process (Cantwell et al. 2004) due to the fact that the products' added value can result in a larger foreign sales revenue share than the domestic sales revenue share for the firm in question (Bagheri, Mitchelmore, Bamiatzi and Nikolopoulos 2019; Knight and Cavusgil 2004; Martínez-Román et al. 2019; Pla-Barber and Alegre 2007; Saridakis, Idris, Hansen and Dana 2019). In line with this topic, the general objective of this article is to analyse innovation as a determinant of the internationalisation patterns of Brazilian technology-based SMEs in different sectors and with different technological features. To address this general objective, our research question is as follows: how do Brazilian technology-based SMEs innovate, and how do the innovation outputs determine internationalisation?.

The main justification of this research comes from the specificities of emerging markets, e.g. Brazil and noteworthy Asian markets, such as China, India, and Malaysia (Falahat et al., 2018), which share common characteristics that differentiate them from advanced economies, thus justifying study of the Brazilian context and providing reasonable grounds for a new inquiry. According to Falahat et al. (2018 p. 937), the distinctive characteristics of emerging markets include infrastructure limitations, less developed socioeconomic performance, higher political risk, and administrative barriers that are prone to affect national economic development and the performance of individual firms. Additionally, emerging markets SMEs are impeded in their internationalisation efforts by limited financial and managerial resources.

This investigation proposes new lines of inquiry, thus filling the research gaps noted by Martínez-Román et al. (2019), who suggested the inclusion of other types of innovation (i.e. nontechnological innovation) to analyse their particular effects on SMEs' market expansion, and that mentioned by Saridakis et al. (2019), who

followed Martínez-Román et al.'s (2019) proposal by calling for examination of the potential effect of each type of innovation and its degree of novelty when measuring the effect of innovation on internationalisation.

The next section presents the theoretical background of this study. The theoretical background analyses innovation typology, focusing on the type of innovation, the degree of novelty, and the degree of control over the innovation process (OECD 2005; Oliva et al. 2019) as well as internationalisation patterns, which are explained based on the following variables: entry mode, market scope, time lag, and foreign sales ratio (Acedo and Jones 2007; Bell, McNaughton, Young and Crick 2003; Crick 2009; Jones and Coviello 2005; Johanson and Vahlne 1977; Knight and Cavusgil 2004; Kuivalainen et al. 2007; Olejnik and Swoboda 2012; Sass 2012; Tuppura et al. 2008), and innovation as an internationalisation determinant, which focuses on the characterisation of innovation output and the ways in which this factor is configured as the firm's main competitive advantage overseas (Bagheri et al. 2019; Martínez-Román et al. 2019; Pla-Barber and Alegre 2007; Saridakis et al. 2019).

Theoretical background

Innovation

Innovation aims to create value and promotes the enhancement of organisational performance, enabling organisations to respond to challenging internal and external environmental changes and to sustain their competitive advantages and market share (Baregheh et al. 2009). Baregheh et al. (2009 p. 1323) affirmed that "[o]rganisations need to innovate in response to changing customer demands and lifestyles and in order to capitalise on opportunities offered by technology and changing marketplaces, structures and dynamics. Organisational innovation can be performed in relation to products, services, operations, processes, and people". The Organisation for Economic Co-operation and Development (OECD 2005, p. 46) complements this explanation and presents the definition of innovation as "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations". In this sense, innovation typology examines the types of innovation, which is divided into technological (product/process) and nontechnological (marketing and organisational) innovation, the degree of novelty (radical/incremental), and the degree of control over the innovation process (open/closed) (OECD 2005; Oliva et al. 2019). Table 1 presents the definition of the innovation types (OECD 2005, p. 48–51).

Radical innovation development demands higher investments and is riskier than incremental innovation development, resulting in new-to-the-world products that cause significant market and organisational changes, and the former type of innovation creates new market demands, which nevertheless may require customers' adaptation to use them and render existing products obsolete or unused. This type of innovation development leads to optimised processes, which aim to reduce costs and the need for time and inputs, to improve organisational performance, and

Table 1 Innovation types

Innovation types	Definition
Product	Introduction of a good or service that is new or significantly improved for its characteristics or intended uses, including significant improvements in technical specifications, components, and materials, incorporated software, user-friendliness, or other functional characteristics
Process	Implementation of a new or significantly improved production or delivery method, including significant changes in techniques, equipment, and/or software
Marketing	Implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion, or pricing
Organisational	Implementation of a new organisational method in the firm's business practices; workplace organisation or external relations

Source: OECD (2005), based on Oliva et al. (2019)

to shift existing technologies to new applications (Christensen and Overdorf 2000; Leifer, McDermott, O'Connor, Peters, Rice and Veryzer 2000; O'Connor 1998). On the other hand, incremental innovation development consists of improvements and enhancements to products that are accomplished through a series of small changes using existing organisational processes and technologies to launch and commercialise the products on the market (Christensen and Overdorf 2000; OECD 2005).

According to Chesbrough (2003, p. 36–37), the open innovation concept is defined as follows: "[…] firms commercialise external (as well as internal) ideas by deploying outside (as well as in-house) pathways to the market. Specifically, companies can commercialise internal ideas through channels outside of their current business in order to generate value for the organisation". On this model, examples of channels include start-ups and licensing agreements. Indeed, the adoption of the open innovation model is not for every organisation, as there are sectors that have to develop innovation internally. In this circumstance, on the closed innovation model, firms rely on their internal R&D, sources of knowledge, and ideas to develop and commercialise innovation.

Internationalisation patterns

SMEs' internationalisation patterns describe the "firm-level behaviour that crosses national borders and can be evidenced at specific points in time" (Olejnik and Swoboda 2012, p. 467). Thai and Chong (2013, p. 389) outlined four variables (timing, market, product, and operation mode) that explain internationalisation patterns, noting that such a pattern "[…] is dynamic and is contingent upon (1) internationalisation motivation which is determined by managers' desire to meet their personal goals or organisational goals, (2) dynamic perception of the external environment which is determined by information available to the firm, and (3) the firm's dynamic capabilities which is determined by the composition of management board and the performance of previous strategies". The Uppsala model (Johanson and Vahlne 1977) analyses the progressive development of a firm's internationalisation process along the "establishment chain", beginning with no regular export activities, which

may evolve to export via independent representatives/agents, sales subsidiaries, and production/manufacturing (Johanson and Wiedersheim-Paul 1975, p. 307). Other entry modes that may also evolve from export include international alliances, nonequity alliances, joint ventures, global sourcing, sales subsidiaries, and foreign direct investment (FDI) (Grandinetti and Mason 2012; Olejnik and Swoboda 2012; Sass 2012; Tuppura et al. 2008).

This model states that internationalisation is a gradual process, as the initial international target markets of the firm are countries that are psychologically and geographically closer, which are approached through low-commitment entry modes, and that other entry modes can then be established gradually and the firm's international market scope can thus be expanded. The gradualness of the internationalisation process extends to the learning process and to knowledge acquisition regarding foreign markets with respect to the comprehension of psychological distance and the use of complex entry modes (Johanson and Vahlne 1977, 2009).

Born-global firms, according to Knight and Cavusgil (2004), leverage innovativeness, knowledge, and capabilities to take advantage of market potential arising from the development of different technologies and innovations and launch their products globally within their first years of existence. Knight and Cavusgil (2004, p. 124) defined born-global firms as "[…] business organisations that, from or near their founding, seek superior international business performance from the application of knowledge-based resources to the sale of outputs in multiple countries." Jones and Coviello (2005, p. 284) defined the internationalisation process of born-global firms "[…] as a rapid process of international expansion from firm inception, using a range of market entry modes in multiple markets." Acedo and Jones (2007, p. 237) declared that born-global firms feature a foreign sales ratio — the ratio of foreign sales to total sales — that varies from 20% of total turnover in 2 years to approximately 80% within 6 years, presenting a range of measures, which may encompass various levels of born-global firms' international performance "[…] according to their degree of involvement in international sourcing and selling activities" (Kuivalainen et al. 2007, p. 254). This measurement, therefore, does not establish a foreign sales ratio cut-off of 25% within 3 years of the firm's founding (Knight and Cavusgil 2004, p. 125).

Hennart et al. (2021, p. 1683) affirmed, based on a sample of Italian SMEs, that certain firms have business models that facilitate rapid foreign sales growth, which enable firms to "[…] export from their home base products and services that do not require host country-specific marketing mix adaptations and do not need foreign-based aftersales service, and this allows them to expand foreign sales quickly and to become BGs (*born-global firms*)", which are characterised as firms that sell 25% of their output to foreign customers. In this study, the variables of the global niche business model are statistically significant, whereas among traditional international entrepreneurship variables (the firm's use of networks and high level of technology and the founders' previous international experiences and linguistic ability), only the founder's prior foreign work experience receives consistent statistical support.

Crick (2009, p. 454; 466) addressed the particularities of born-global firms and international new ventures and found, through a quantitative study, few significant differences between measures and sources of performance in overseas markets

several years after internationalisation took place. According to the qualitative study, data taken from interviews with the management teams of born-global firms and those of international new ventures revealed the routes by which the respective types of firms internationalised were noticeably different, reflecting the global focus of the first group and the regional focus of the second group. Even though both groups were engaged in export activities, born-global firms exploited the FDI entry mode in key markets, while international new ventures opted for less commitment to all but the core markets, exploring collaboration as an entry mode, which provided sufficient flexibility to enable managers to decide whether to continue selling to country markets that were considered peripheral. Therefore, the terms designating these rapidly internationalising firms should not be used interchangeably.

The last internationalisation pattern is that of the born-again global firm. Born-again global firms, like rapidly internationalising firms, are also committed to a global market expansion (Bell et al. 2003). However, born-again global firms do not initiate the internationalisation process from inception, as their primary focus is the domestic market. Born-again global firms first acquire business management experience and attain strategic resources that support competitiveness in domestic markets, which, subsequently, may contribute to successful international market expansion (Bell et al. 2003; Tuppura et al. 2008). The "critical incidents" that trigger the international expansion of born-again global firms are as follows: management buyout, the focal firm being taken over by another firm, a firm that had ceased trading or was in receivership being acquired either by existing management or by a third party, a change in ownership and/or management introducing new decision-makers with a greater international orientation, which is accompanied by an infusion of additional finance and access to networks in overseas markets, an existing domestic customer internationalising and the firm continuing to engage with this customer in new foreign markets or a new customer who had already operated internationally entering the home market (Bell et al. 2003, p. 345).

Innovation as an internationalisation determinant

In this section, we consolidate the theoretical background concerning the ways in which innovation sustains organisations' competitiveness and promotes superior sales performance in domestic and international markets by reference to central papers that support our research data analysis (Bagheri et al. 2019; Chetty and Stangl 2010; D'Angelo 2012; Knight and Cavusgil 2004; Martínez-Román et al. 2019; Pla-Barber and Alegre 2007; Saridakis et al. 2019; Oxtorp and Elg 2015; Vernon 1966). Vernon (1966) is author working in this field from the beginnings of the relevant literature.

Vernon's (1966) main premise of Product Cycle theory was located in analysis of the factors that lead to the emergence of a certain type of product in a particular country and, subsequently, the possibility of shifting production of that product abroad. During the "Location of New Products" stage (p. 191), the analysis draws attention to firms from developed (i.e. as noted in the text, advanced) countries,

which have superior access to scientific and technological knowledge. Due to this ease of access, these firms have more opportunities for product (goods/services) innovation development if entrepreneurs recognise the gap between scientific and technological knowledge and the embodiment of this knowledge in the development and manufacture of a new product. However, entrepreneurs must be willing to accept the risks involved in testing whether this gap can be bridged (p. 191–192). The products in this case are new high-income or labour-saving products (p. 194) with an elevated initial price to serve high-income demands. Subsequent to "The Maturing Process" stage (p. 196), "The Standardized Product" stage (p. 202) poses a series of strategic choices to entrepreneurs to decide whether the production location of standardised products is more competitive in developing (i.e. as noted in the text, less-developed) countries than in developed countries. One of the main choices in this context is the entrepreneur's decision to invest in overseas production plants for labour-intensive standardised products (products that do not require major specifications) in developing countries, which may present certain advantages, such as reduced production costs due to significant inputs of low-cost labour (p. 203) and the openness of these economies to investment in facilities to produce standardised products due to capital scarcity (p. 205).

Revisiting Vernon's (1966) Product Cycle theory, Pessoa and Martins (2007) discussed the valid contemporary assumptions of this theory. The first such assumption refers to a pioneering attempt to incorporate the role of innovation, production scale, external economies, and uncertainties into international trade and production theory. Therefore, this theory sheds light on the notion of making the concept of comparative cost advantages more dynamic, as it establishes hypotheses concerning investment location decisions and international production that surpass the notion of static comparative advantages, i.e. a traditional explanation of commerce and production drawn from neoclassical theory. Furthermore, if it is true that Product Cycle theory does not explain the flow of foreign direct investment in the current context of world market integration, it can still elucidate, in specific cases, the internationalisation strategy of MNEs, as they tend to concentrate innovative investments and technologically complex production activities in their home (developed) country, whereas production is shifted to (developing) countries that are rich in natural resources and/or less expensive labour. After explaining the Product Cycle theory (Vernon 1966), we present additional recent research concerning innovation as an internationalisation determinant, emphasising the fact that this field is an evolving area of study.

Pla-Barber and Alegre (2007) affirmed that there is a positive link between innovation and export intensity in biotechnology industries. The features of this industry are driven by the effectiveness of research, and firms are considerably more globalised due to the ease of accessing market information and the fact that possible entry barriers are not relevant to export activity. Export performance in this context is better explained through innovation and technology instead of size in industries developing cutting-edge technology, implying that managers have to develop and protect their key resources, i.e. technology competences.

D'Angelo (2012), based on findings from a quantitative survey of Italian high-tech SMEs, found a strong correlation between number of R&D employees and

export intensity and noted the role of other variables in this relationship, such as external sources of R&D, in particular partnerships with universities, which facilitate the development and exchange of knowledge between firms and universities. These results are in agreement with the findings of Chetty and Stangl (2010), Pla-Barber and Alegre (2007) and Oxtorp and Elg (2015), as these studies also noted the influence of variables such as internal R&D investments and external sources of R&D in the analysis of export intensity.

Technological innovation development in the context of SMEs has a positive effect on internationalisation, as innovative SMEs that develop radical and/or incremental innovations in goods are more likely to export than are noninnovative SMEs (Saridakis et al. 2019). According to Martín-Román et al. (2019), manufacturing firms engage in more technological activities, which lead to a more pronounced positive effect of innovation on internationalisation and, due to their possession of ample knowledge and their experience accumulated in dynamic and complex contexts, risks decrease among the most innovative organisations. Moreover, Bagheri et al. (2019) pointed out, based on a survey of international SMEs operating in several innovative industries in the UK, that an international orientation (inward-outward) fosters technological innovation development; at the same time, product and process innovation development enhance opportunities for international orientation. In addition to this direct relationship, an indirect relationship between international orientation and international performance is also expected.

The next section presents the empirical study. The first part of this section presents the research design, which explains the entire research process and the qualitative research data analysis. The second part of this section presents the measurements of the innovation and internationalisation variables.

Empirical study

Research design

The Ministry of Economy provides the main online public databases concerning exporting firms based in Brazil used in this research (Ministry of Economy 2022 [Ministério da Economia 2022]). The current version of the online public database "List of Brazilian Exporting and Importing Companies" (*Lista de Empresas Brasileiras Exportadoras e Importadoras*) contains fundamental data related to exporting firms based in Brazil. This database is updated annually, and a full version of this list is available online at the beginning of the subsequent year. This database is also partially updated during the current year.

During the period of database selection, the sampling process, and the definition of case firms included in the empirical study, which was from September 2014 to December 2015, the database "List of Brazilian Exporting and Importing Companies" contained other data than it currently contains. Formerly hosted at the website of the Ministry of Industry, Foreign Trade and Services, which no longer exists, and

currently housed by the Secretary of Foreign Trade and International Affairs, which is integrated into the organisational structure of the Ministry of Economy, this database presented, in addition to data related to exporting firms based in Brazil, the individual export value range of the firms. After checking the Ministry of Economy (2021) homepage to confirm the web address of the 2014 and 2015 databases, we found a statement explaining that this database, no matter the year it contains, no longer provides the individual export value range of the firms because, due to Brazilian law, "[i]n compliance with tax secrecy and company privacy, information that reveals business characteristics of exporting and importing companies, such as products, business partners or volumes traded, will not be published. Only registration information will be disclosed (see Brazilian law)" (Ministry of Economy 2022 [Ministério da Economia 2022]). This data restriction does not invalidate the research design that focuses on data from 2014 to 2016, and the selected case firms fulfil the eligibility criteria.

The current version of the database "List of Brazilian Exporting and Importing Companies" presents fundamental data pertaining to firms' identification, which are organised as follows: the Brazilian National Registry of Legal Entities (*Cadastro Nacional da Pessoa Jurídica [CNPJ]*), the name and the complete address, the firm's economic activity, based on the National Classification of Economic Activities (*Classificação Nacional das Atividades Econômicas [CNAE]*) and the legal constitution of the firm (Ministry of Economy 2022 [Ministério da Economia 2022]).

The first part of database (Ministry of Economy 2022 [Ministério da Economia 2022]) processing aimed to remove duplicated data and to select firms according to their export performance, which was determined through their export value ranges, and according to their location in the state of São Paulo to produce the main sample. From this main sample, we searched the homepages of the firms to determine their sector and main product. Firms belonging to sectors other than technology-based sectors or firms that did not have a homepage or any telephone number available online were excluded from this main sample. From this second database processing, the number of firms in the main sample was reduced, and the remaining firms were industries of technology-based sectors (OECD 2011).

Then, we called each of the remaining firms in the main sample via telephone to briefly explain the general objective of the research to the telephone attendant and request the email addresses of the managers or directors of the firms. If that the telephone attendant provided the email addresses to us, we then contacted the managers or directors of the firms via email to inform them of the general objective of the research and to ask for the following information: the number of employees of the firm in 2014 and whether the capital of the firm was exclusively national. Here, we also excluded firms that we were not able to reach via telephone, firms whose telephone attendants did not provide the emails of the managers or directors, and firms whose managers or directors we were not able to contact via email. In this phase, another reduction in the number of remaining firms in the main sample took place. After receiving valid data provided by the managers or directors whom we were able to contact via email, we verified these data and subsequently invited the managers or directors of the firms that complied with all the eligibility criteria via

email to be part of the empirical study. From the contingent of managers or directors of the firms that accepted our invitation, we defined a sample of six representative case firms in the state of São Paulo to be part of the case study (Yin 2018), which took place from September 2015 to December 2015. In sum, the complete criteria list for classifying an exporting firm as eligible is as follows: in 2014, the firm had fewer than 499 employees (Brazilian Supporting Service for Micro and Small Enterprises – *Serviço Brasileiro de Apoio às Micro e Pequenas Empresas [SEBRAE]* and Inter-Union Department of Statistics and Socio-Economic Studies – *Departamento Intersindical de Estatística e Estudos Socioeconômicos [DIEESE]* 2013); the firm was a technology-based industry from a variety of sectors and with a variety of technological features, and the capital of the firm was exclusively national. It is worth noting here that the six case firms, according to updated information recorded in December 2021, continue to be exporters (Ministry of Economy 2022 [Ministério da Economia 2022]).

With respect to data collection, the respondents of the six case firms (Eisenhardt 2007, p. 545) were managers or directors, which ensured data precision and reliability. Interviews were held *in loco*, except for case firm C, which was conducted in the firm's office in a different city from the firm's industrial complex, thus not allowing for a visit to the industrial complex. Interviews were transcribed verbatim, and the text was carefully translated from Portuguese to English, maintaining the same sense and meaning of words in Portuguese, although minor adaptations were made in the translation to English. The average duration of the interviews was one hour and twenty-nine minutes. In addition to data from the interviews with the respondents, other sources of data were used to employ the triangulation method, including additional data obtained from the managers or directors of the firms via email or via firms' websites, the portfolio of products, internal documents and reports of the firms, visits to the firms and secondary data taken from online public databases. In terms of ethical procedures, all respondents from the six case firms received a formal letter via email. The main content of this letter pertained to data confidentiality, which emphasised the fact that only the researchers involved had access to primary and secondary data. To assure trustworthiness in analysing the research data, at the end of this phase, we sent the research data analysis text for each case firm to the respective respondent, who examined and verified it to check for possible misinterpretations or incorrectness. In case of inaccuracies, we promptly corrected these errors and subsequently returned the text to respondents to validate the research data analysis text once again.

Research data analysis occurred from January 2016 to March 2016. Miles et al. (2014) provided the theoretical assumptions that were fundamental to the qualitative research data analysis and allowed us to structure this process. After data collection and transcription of the interviews, data analysis consisted of writing summaries, coding, developing themes, generating categories, and writing analytic memos. The first step was descriptive data analysis, i.e. within-case analysis, and the second step was comparative data analysis, i.e. cross-case analysis. Based on Oliva et al. (2019, p. 147), we used the free trial version of the ATLAS.ti (version 7.5.10) qualitative data analysis research software, which was downloaded from the ATLAS.ti website (https://atlasti.com/), to support the research data analysis (Miles et al. 2014).

This research design was in agreement with Coviello's (2015) remarks concerning Knight and Cavusgil's (2004) detailed explanation of such research design, which may serve as a model for other researchers. In our investigation, we had to pay close attention to this process not only in order to specify and develop the research phases but also primarily as a result of the use of multiple data sources.

Measurements

To contemplate the multidimensionality of innovation (Baregheh et al. 2009), the interview guide contained retrospective questions regarding innovation (OECD 2005; Oliva et al. 2019) during the period from 2010 to 2012 (OECD 2005), except with respect to case firm A, as the analysed period for this case was from 2010 to 2015 due to the specificity of product innovation development in the defence and space sector. We employed two definitions to operationalise and describe the technological and nontechnological innovation development of case firms. The first definition was that of "capabilities" (Teece et al., 1997, p. 515) as "[…] the key role of strategic management in appropriately adapting, integrating, and reconfiguring internal and external organizational skills, resources, and functional competences to match the requirements of a changing environment". The second definition was that of "microfoundations" (Nguyen and Mort, 2021, p. 1787, based on Eisenhardt et al., 2010) as "[…] the foundational layer at which the dynamic accumulation of and interactions among individual-based routines, resources, skills and expertise occurs for subsequent conversion into firm-level organisational capabilities. By 'foundational layer', we mean microfoundations exist since the birth of the organisations an continue to be the ground on which organisational capabilities build up. From the beginning, microfoundations consists of a stock of individuals' resources, and appropriate transforming mechanisms to convert them into macro-level capabilities. Consequently, microfoundational resources, in our view, is not a static concept but a dynamic one that strengthens and evolves over time along with organisational capabilities".

In line with Olejnik and Swoboda (2012), the interview guide contained retrospective questions pertaining to internationalisation, and the case firms studied by this research were mature SMEs. Respondents discussed entry modes other than exporting throughout the internationalisation process of the firm. To measure market scope, we asked respondents to identify the countries in which they operated at two time points or at additional time points if relevant. The first time point was the beginning of the internationalisation process, here considered to be the first year of international operations, thus not accounting for internationalisation preactivities (Johanson and Wiedersheim-Paul 1975), and the second time point was 2014. Respondents were able to provide further information concerning the number of country markets to identify changes in the market scope of the firm throughout its internationalisation process. Answers were divided into three categories: countries bordering Brazil; South, Central, and North American countries; and countries worldwide. Geographical diversification means that the market scope of the firm includes a large

number of country markets; on the other hand, geographic concentration signifies that the firm focuses on a limited number of country markets to achieve its market share (Tuppura et al. 2008).

The variables used in research pertaining to born-global firms and born-again global firms include time lag, also called entry timing (Tuppura et al. 2008), and foreign sales ratio (Olejnik and Swoboda 2012). Considering the definitions of born-global firms, we have to establish measures for time lag and foreign sales ratio. Acedo and Jones (2007) proposed a range of measures, specifying the foreign sales ratio in terms of time-points, whereas Olejnik and Swoboda (2012) created categories to measure both time lag and foreign sales ratio and Knight and Cavusgil (2004), in turn, set the cut-off point for foreign sales ratio and established the maximum number of years from domestic establishment to initial foreign market entry. Therefore, the measure of time lag was set to three years from the firm's inception (Knight and Cavusgil 2004), and the foreign sales ratio was measured by the following categories: 0–10, 11–25, 26–50, and 50–100% (Olejnik and Swoboda 2012, p. 476). Table 2 presents the measurement criteria for these variables.

The next section presents the research data analysis. This section presents the research data analysis of each case firm, beginning with a brief introduction to the firm and the profile of the respondent. The research data analysis continues with a description of the innovation of the firm, focusing on the type of innovation, the degree of novelty, and the degree of control over the innovation process. Subsequently, the description of the internationalisation focuses on internationalisation patterns.

Table 2 Measurement criteria for the variables

Variable	Measure	Internationalisation pattern
Entry mode	Direct and indirect exports Franchise International strategic alliance Joint venture Foreign direct investment (FDI)	Traditionally internationalising firms Born-global firms International new ventures Born-again global firms
Market scope	Countries bordering Brazil	Traditionally internationalising firms
	South, Central, and North American countries	International new ventures
	Worldwide	Born-global firms Born-again global firms
Time lag	Late	Traditionally internationalising firms Born-again global firms
	3 years from the firm's inception	Born-global firms International new ventures
Foreign sales ratio	0–10, 11–25, 26–50, and 50–100%	Traditionally internationalising firms Born-global firms International new ventures Born-again global firms

Source: Authors (2020), based on Acedo and Jones (2007), Bell et al. (2003), Crick (2009), Johanson and Vahlne (1977, 2009), Jones and Coviello (2005), Knight and Cavusgil (2004), Olejnik and Swoboda (2012), and Sass (2012)

Research data analysis

Case firm A: A born-global firm

Founded in 1986, case firm A is part of a national group of enterprises and belongs to the ophthalmic and medical equipment sector as well as to the defence and space sector. In 2014, the firm had an average of 150 employees. The respondent holds a Ph.D. in Physics, is one of five owners, and is the R&D&I (Research & Development & Innovation) director.

Product innovation development

During the period from 2010 to 2015, the firm developed eleven product innovations (goods) based on continuous improvement, which is the result of incremental innovation development (OECD 2005; Oliva et al. 2019), in both sectors. According to the respondent, the current innovation strategy of the firm is incremental innovation development, as this approach is less risky than radical innovation development and does not demand a large time horizon or a considerable investment.

Product innovation development in the ophthalmic and medical equipment sector

The firm's portfolio of products features ophthalmic and medical laser equipment for ophthalmic and retinal surgery and treatment of the human eye. Laser applications of the firm's products in both sectors are the outcome of the innovation path of the firm, which, throughout its existence, developed product innovations based on continuous research in Physics and Optics. With a brochure addressing the firm's portfolio of products in hand, the respondent explained the functions, finalities, and type of laser control of each piece of ophthalmic and medical laser equipment used for ophthalmic and retinal surgery and treatment of the human eye. These pieces of equipment must satisfy ergonomic conditions to facilitate safe and effective use by doctors.

Internationalisation of the ophthalmic and medical equipment sector

The internationalisation pattern of the ophthalmic and medical equipment sector, according to the measurement criteria in Table 2, is that of a born-global firm. Table 3 presents the characteristics of the firm's internationalisation.

The internationalisation process of this sector began in 1987 through exports due to business networks that afforded overseas opportunities, and this process thus did not result from formal strategic planning with respect to initiating international operations. According to the respondent, the firm's entry into business networks and partnerships was vital to both innovation and internationalisation. Additionally, throughout the internationalisation process, during a specified period, the firm had a subsidiary in Australia to take advantage of commercial benefits with respect to selling its products to the USA.

Table 3 Internationalisation of the ophthalmic and medical equipment sector

Variables	Research data
Time lag	1987 (1 year after the firm's inception)
Foreign sales ratio in 1987	~3%
Market scope	North America — 100%
Foreign sales ratio in 2014	~5%
Market scope	Asia and Oceania — 30% Europe — 20% North America — 50%

Source: Authors (2022), based on research data analysis (2016)

Product innovation development in the defence and space sector

The firm's portfolio of products includes satellite cameras, thermal sights, and components of missiles, such as seekers. Product innovation development in the defence and space sector must follow specific military doctrines and parameters to satisfy the requirements of the client nation. Considering the need for product innovation development with respect to the Brazilian Army, the firm has to employ certain methodologies to prevent and reduce risks to the Brazilian government as specified in its contract. The respondent mentioned the substantial importance of contract confidentiality and secrecy with respect to product and process innovation development. This closed innovation development significantly relies on internal innovation development or at most on development through partnerships with the R&D departments of national armies.

There are international boycotts that constrain the firm's innovation. Consequently, the respondent explained that there are technologies, devices, components, and materials that are not available or accessible and hence cannot be used to promote the firm's innovation. In this sense, even though other firms or the R&D departments of national armies encourage product and process innovation, the firm does not have access to this knowledge. Due to this limitation, the innovation process in the defence and space sector is confidential and aims to provide new industrial processes and solutions to promote further advances in product innovation development. This condition obligates the firm to maintain long-data specialised staff and an internal R&D department, and to invest in its own industrial structure to innovate and conduct essays and tests with different inputs. Multisectoral firms are able to employ the same resource base to innovate; in this case, process innovation development can be applied to both sectors.

At the end of the interview, the respondent displayed the industrial structure of the firm's factory and the technologies involved in the manufacturing and R&D processes (laboratories, machinery, equipment, materials, devices, and ICT — Information and Communications Technology) and introduced other members of the staff. The respondent also presented the firm's museum, which contains products from the ophthalmic and medical equipment sector and those from the defence and space sector that have been developed throughout the years of the firm's existence.

Internationalisation of the defence and space sector

The internationalisation pattern of the defence and space sector, according to the measurement criteria in Table 2, is that of the born-global firm. Table 4 presents the characteristics of the firm's internationalisation.

The internationalisation process in this sector began in 1989. According to the respondent, the firm was hired to develop research and establish a manufacturing unit in a Middle Eastern client nation to produce optical components for missiles and military defence systems locally. The project started, the firm expatriated the staff, and they began to develop prototypes for the products. During this period, the outbreak of the Gulf War occurred in 1990, forcing the firm to interrupt the project and repatriate the staff. In 2014, the firm was engaged in a joint project with a South African firm to develop optical components for missiles.

Case firm B: A born-again global firm

Founded in 1976, case firm B belongs to the manufacture of refractory ceramic products sector. In 2014, the firm had an average of 97 employees. The first respondent holds a Bachelor's degree and a Master's degree in Materials Engineering and is the manufacturing control manager. The second respondent also holds a Bachelor's degree and a Master's degree in Materials Engineering and is the export manager.

Product innovation development

During the period from 2010 to 2012, the firm developed seven product innovations (goods) based on continuous improvement, which were the result of incremental innovation development (OECD 2005; Oliva et al. 2019). The firm's portfolio of products includes ceramic refractory products.

The first respondent explained that product innovation development is based on the customisation of products, which means there are modifications to the format of the product to satisfy specific technical conditions according to the specifications of the customers; however, the base, the ceramic mass used to manufacture products, does not change. Innovation is based on innovative activities that support the

Table 4 Internationalisation of the defence and space sector

Variables	Research data
Time lag	1989 (3 years after the firm's inception)
Foreign sales ratio in 1989	~10% — this is a partial value, as the project was interrupted due to major constraints
Market scope	Middle East — 100%
Foreign sales ratio in 2014	10% — this is a partial value, as the project was in progress
Market scope	Africa — 100%

Source: Authors (2022), based on research data analysis (2016)

customisation of the product. The identification and mapping of innovative activities correspond directly to comprehension of the innovative characteristics and to identification of the organisational resources employed in this process (Jaramillo, Lugones and Salazar 2001).

At the end of the interview, the second respondent displayed the industrial structure of the firm's factory and the technologies involved in the manufacturing and R&D processes (laboratories, machinery, equipment, materials, devices, and ICT) and introduced other members of the staff. During the visit to the firm, the second respondent also explained the physical–chemical characteristics of the inputs used to obtain the ceramic mass, which is laboratory-tested to verify its physical–chemical properties.

Internationalisation

The internationalisation pattern of case firm B, according to the measurement criteria in Table 2, is that of a born-again global firm. Table 5 presents the characteristics of the firm's internationalisation.

The internationalisation process of the firm began in 1984 due to the recognition of opportunities to export to neighbouring countries that, like Brazil, imported refractory ceramic products from Italy. The linguistic proximity between Spanish and Portuguese, cultural similarities, and connections between the ways of conducting business among these countries were also positive factors that contributed to internationalisation. According to the second respondent, the historical economic cycles of Brazil had influence on this process, since these cycles lead to the commercial intensification of the domestic market in periods of a favourable internal economy and to international commercial expansion in periods of a favourable external economy and a retraction of the domestic economy. These economic cycles are, therefore, the "critical incidents" (Bell et al. 2003, p. 345) that led to strategic changes with respect to the internationalisation process of the firm.

Table 5 Internationalisation of case firm B

Variables	Research data
Time lag	1984 (8 years after the firm's inception)
Foreign sales ratio in 1984	15–20%
Market scope	South America — 100%
Foreign sales ratio in 2000	30%
Market scope	North America — 7% South America — 93%
Foreign sales ratio in 2014	70–75%
Market scope	Africa — 5% Europe — 12% Middle East — 3% North America — 42% Oceania — 2% South America — 36%

Source: Authors (2022), based on research data analysis (2016)

Case firm C: A born-again global firm

Founded in 1950, case firm C is under family control and belongs to the foods and beverages sector. In 2014, the firm had an average of 200 employees. The first respondent holds a Bachelor's degree in Social Communication with an emphasis on Marketing and is the product manager. The second respondent holds a Bachelor's degree and is the international trading manager. In addition, a member of the staff, a Marketing specialist, also attended the interview.

Marketing innovation development

During the period from 2010 to 2012, the firm developed one radical marketing innovation (OECD 2005; Oliva et al. 2019). The firm's portfolio of products includes the *cachaça*, a commodity and a genuinely Brazilian alcoholic beverage (Edict Nº 4.062, December 21st, 2001, Palácio do Planalto 2001 [*Decreto Nº 4.062, de 21 de dezembro de 2001,* Palácio do Planalto 2001]), and other alcoholic beverages, such as vodka and gin. According to the first respondent, the production process of *cachaça* in the four factories employed by the firm is a large-scale industrial process.

The marketing innovation of the firm was the development of ostentatious bottles, which aimed to strategically place the organisation in the luxury market. This marketing innovation was a radical and unprecedented innovation in the foods and beverages sector according to both respondents (OECD 2005; Oliva et al. 2019). Inspired by a visit to a cosmetics and perfumery trade fair in 2005, the second respondent had the idea to apply the sophistication, elegance, and refinement of cosmetic packages and perfume bottles to bottles of *cachaça*. The design of this unique bottle is on-demand and customised, as customers may improve the design of the bottle with elements such as precious gems and personalised details.

The bottling process of *cachaça* in sophisticated bottles requires adjustments to the manufacturing process, which is conducted in specific factories employed by the firm and is supervised by industrial staff. With respect to managing this marketing innovation, the first respondent emphasised the importance of meetings with suppliers to monitor the development of this bottle as well as the business perceptions of the international trading manager, who is responsible for taking account of market trends discovered at international trade fairs for the foods and beverages sector in terms of package, design and artistic appeal. Even though this development is a significant marketing innovation that promotes the firm's organisational goals, the largest sales revenue share of the firm, both nationally and internationally, comes from *cachaça* sold in traditional bottles.

Internationalisation

The internationalisation pattern of case firm C, according to the measurement criteria in Table 2, is that of a born-again global firm. Table 6 presents the characteristics of the firm's internationalisation.

Table 6 Internationalisation of case firm C

Variables	Research data
Time lag	1998 (48 years after the firm's inception)
Foreign sales ratio before 1998	Not specified
Market scope	Portugal and Chile — 100%. The sales percentage for each country is not specified
Foreign sales ratio in 2014	Not specified
Market scope	The firm's product is exported to several countries

Source: Authors (2022), based on research data analysis (2016)

The internationalisation process of the firm began through indirect exports to Portugal and Chile, which were mediated by a trading company. The intentional internationalisation of the firm began in 1998 due to the hiring of the second respondent, who has professional experience in corporations. This "critical incident" (Bell et al., 2003, p. 345) provoked major changes in terms of strategic planning for internationalisation, prompting a restructuring of the export department and a formalisation of the export permissions of the firm. During part of 1998 and in 1999, the international trading manager visited approximately twenty-five countries to promote the firm's product (*cachaça*) internationally, relying on the relevant legal basis (Edict Nº 4.062, December 21st, 2001, Palácio do Planalto 2001 [*Decreto Nº 4.062, de 21 de dezembro de 2001,* Palácio do Planalto 2001]), on the *Brazilianness* of the beverage (Cardoso 2012; Sutter, Mac Lennan, Tiscoski and Polo 2015) and on the country-of-origin-image (COI) (Roth and Diamantopoulos 2009) of the product as positive factors that promoted the success of this process. The firm exports *cachaça* to distributors (importers) located in individual country markets, which are responsible for the process of distributing the product via various sales channels.

Case firm D: A traditionally internationalising firm

Founded in 1995, case firm D is under family control and belongs to the manufacture of fertilizers sector. In 2014, the firm had an average of 120 employees. The first respondent holds a Bachelor's degree in Business Administration and a Postgraduate degree in Human Resources and is the export and international trading manager. The second respondent holds a Bachelor's degree in Business Administration and a Postgraduate degree in Controlling and Finance and is the business management director. The third respondent holds a Bachelor's degree in Biology and works in the research and product development and biological control departments.

Product innovation development

During the period from 2010 to 2012, the firm developed sixteen product innovations (fifteen goods innovations and one service innovation) based on continuous improvement, which is the result of incremental innovation development (OECD 2005; Oliva et al. 2019). The firm's portfolio of products includes biological fertilizers.

The second respondent stated that the research and product development department is responsible for product innovation development. According to this respondent, product innovation development features customisation, which means that modifications to the biological fertilizers' formulas might be necessary to satisfy soil and plantation needs while simultaneously respecting climatic conditions according to the specifications of the customers. The service innovation is the package's customisation for the brand of a Paraguayan client, developed in-time by the design staff of the firm to complete the sales process.

The third respondent emphasised the environmentally sustainable practices of the firm. Biotechnology is summarised as "[…] the use of living organisms or biological molecules for developing new technologies or creating new commercially interesting products and it has spread through multiple fields such as drug design, health, plant and animal breeding, biofuel production and many others" (Carvalho et al. 2019, p. 195) and is employed in the production process of biological fertilizers. The utilisation of microorganisms in the production process of biological fertilizers not only aims to facilitate product customisation but also enables the development of a cleaner production system. The firm also features water treatment and waste recycling systems as part of its environmentally sustainable practices.

In terms of process innovation development, the firm is constantly working on the standardisation of the production process through the application of routine techniques, aiming to reduce losses and improve productivity. Productivity is measured through the performance of product inputs, leading to an increase in sales. This manufacturing control results in an improvement of the production processes and serves as the basis for product innovation development. At the end of the interview, the second respondent displayed the industrial structure of the firm's factory and the technologies involved in the manufacturing and R&D processes (laboratories, machinery, equipment, materials, devices, and ICT), the storage silos, and the water treatment and waste recycling systems.

Internationalisation

The internationalisation pattern of case firm D, according to the measurement criteria in Table 2, is that of a traditionally internationalising firm. Table 7 presents the characteristics of the firm's internationalisation.

Table 7 Internationalisation of case firm D

Variables	Research data
Time lag	2001 (6 years after the firm's inception)
Foreign sales ratio in 2001	3.5%
Market scope	South America — 100%
Foreign sales ratio in 2014	8%
Market scope	South America — 100%

Source: Authors (2022), based on research data analysis (2016)

The internationalisation process of this firm began in 2001 with imports of inputs from Chile, Bolivia, and Argentina, as the costs of imported inputs were more competitive than those of domestic inputs, as well as with exports to Bolivia and Paraguay. The choice of Paraguay and Bolivia as the first target markets for export was due to logistics conditions that favoured the transportation of biological fertilizers. According to the second respondent, there has been no decrease in international sales since the beginning of this operation, which means that the firm highlights international commerce as a strategic goal.

Case firm E: A traditionally internationalising firm

Founded in 1952, case firm E is under family control, is part of a national group of enterprises, and belongs to the manufacture of ceramic tiles sector. In 2014, the firm had an average of 400 employees. The respondent holds a Ph.D. in Geology, is the director, the main hereditary successor of the firm, and is responsible for the research and product development and the quality and manufacturing control departments. The financial and administrative manager also provided additional data via email.

Product innovation development

During the period from 2010 to 2012, the firm developed one product innovation (goods) based on continuous improvement, which is the result of incremental innovation development (OECD 2005; Oliva et al. 2019). The firm's portfolio of products includes ceramic tiles.

The product innovation of the firm was the resizing of ceramic tiles from 40 to 60 cm^2. According to the respondent, incremental innovation development aims to improve the quality of products. This improvement is the result of upgrades to the manufacturing process of the firm, workforce training and improvements to the ceramic mass and the granulating and grinding phases. This improvement consists of changes in the preparation of the ceramic mass — a shift from a wet grinding process to a dry grinding process — as the final product in this latter process absorbs between 6 and 10% of water, which is a lower water consumption than that required for the former process and has better energy efficiency. The acquisition of machinery, a digital printer and a digital serigraph, aimed to broaden the firm's portfolio of products and was part of product innovation development, as this technology enabled modifications to the ceramic tiles to improve the product's characteristics and design.

At the end of the interview, the respondent displayed the industrial structure of the firm's factory, explaining the entire production process for ceramic tiles and presenting the technologies involved in the manufacturing and R&D processes, which included the following: laboratories, machinery, including the digital printer and the digital serigraph, equipment, materials, devices, and ICT. The respondent also

demonstrated the external aspects of the factory, the deposits that store the products' inputs, and the final product after having been packaged and ready for sale.

Internationalisation

The internationalisation pattern of case firm E, according to the measurement criteria in Table 2, is that of a traditionally internationalising firm. Table 8 presents the characteristics of the firm's internationalisation.

The internationalisation process of this firm began in 2005 due to the recognition of opportunities to export ceramic tiles to Latin American country markets, mainly to the Chilean market, based on information provided by international strategic alliances. The importance of the Chilean market decreased during the first decade of the 2000s because of the entry of Chinese competitors in the global ceramic tiles market and the ascension of the Chilean ceramic tiles industry. Then, the firm started exploring additional foreign markets. Even though international commerce is important to the firm, the respondent emphasised the paramount role of the domestic market, which corresponds to a significant sales revenue share for the firm.

Case firm F: an international new venture

Founded in 2002, case firm F belongs to the manufacture of electronic components for installation in electric energy systems sector. In 2014, the firm had an average of 50 employees. The first respondent holds a Bachelor's degree in Electrical Engineering, is the commercial director, and is one of seven owners of the firm. This respondent is also in charge of the decision-making process concerning innovation, which is focused on the firm's product engineering department. The second respondent holds a Bachelor's degree, is the commercial manager, and is responsible for both domestic and international commerce.

Table 8 Internationalisation of Case Firm E

Variables	Research data
Time lag	2005 (53 years after the firm's inception)
Foreign sales ratio in 2005	Small to medium share of foreign sales, as the firm's focus was on the domestic market
Market scope	Focus on South America
Foreign sales ratio in 2014	Small to medium share of foreign sales, as the firm's focus was on the domestic market
Market scope	Central America – 61% Europe – 1% North America – 6% South America – 32%

Source: Authors (2022), based on research data analysis (2016)

Product innovation development

According to the first respondent, a major goal of the firm is to develop two innovations with respect to its products (goods) every year, regardless of their degree of novelty (OECD 2005; Oliva et al. 2019). The firm's portfolio of products includes electronic components for installation in electric energy systems.

The firm has commercial, administrative, financial and product engineering departments. This last department is the "core competence" of the firm, as emphasised by the first respondent, as this department includes a specialised staff responsible for product innovation development. The product engineering department has a 3D printer and ICT that include software used for product conception, projection, and development. During the visit to the firm, the first respondent displayed the four departments, the industrial structure of the firm's factory, and the technologies involved in the manufacturing and R&D processes (laboratories, machinery, equipment, materials, devices, and ICT). The firm's laboratory is used to test and verify the properties of products for electric energy grid systems to ensure the conformity of the products' technical characteristics and functionalities.

Internationalisation

The internationalisation pattern of case firm F, according to the measurement criteria in Table 2, is that of an international new venture. Table 9 presents the characteristics of the firm's internationalisation.

The internationalisation process of the firm began in 2005 with exports, focusing on Latin American country markets until 2010, for the following reasons: geographic proximity, ease of access, the Southern Common Market (*Mercado Comum do Sul — MERCOSUL*) commercial agreement, and the fact that the firm's products met the technical requirements of these countries.

The sales representatives are well-trained and have technical knowledge concerning the firm's products; thus, they are able to participate in trade fairs and to present the technical characteristics and functionalities of the products to customers — representatives of firms in the electric energy sector — who want to know that new products meet the technical requirements of the electric energy grid systems in their locations and are produced by certified firms. This staff is also able to provide

Table 9 Internationalisation of case firm F

Variables	Research data
Time lag	2005 (3 years after the firm's inception)
Foreign sales ratio in 2005	3.18%
Market scope	South America — 100% (until 2010)
Foreign sales ratio in 2014	14.44%
Market scope	Africa – 2% Middle East – 3% South America – 95%

Source: Authors (2022), based on research data analysis (2016)

training to customers to explain how to install the firm's products in electric energy grid systems.

The next section presents the comparative data analysis, which focuses on presenting the common findings concerning the innovation and the internationalisation of case firms. This section highlights the theoretical contributions of this qualitative study.

Comparative data analysis

The main theoretical findings of this article include the prevalence of incremental innovation development in products (goods), which was found in case firms A, B, D, and E, that of innovation development in products (goods), regardless of their degree of novelty, which was found in case firm F, and that of radical innovation development in Marketing, which was found in case firm C, as determinants of the internationalisation patterns of Brazilian technology-based SMEs in different sectors and with different technological features.

In connection with the second main theoretical and practical contribution of this research, we define the external organisational environment in terms of the Brazilian legal, political, economic and tax systems as well as in terms of the regulatory institutions and bureaucratic procedures of the public administration, which is responsible for organising and structuring social life. This viewpoint follows the claim of Teece et al. (1997, p. 522) that "[…] [e]nvironments cannot be defined in terms of markets alone. […] [I]nstitutions themselves are a critical element of the business environment. Regulatory systems, as well as intellectual property regimes, tort laws, and antitrust laws, are also part of the environment". The factors of the external organisational environment that exert influence on innovation in developing countries are "[…] macroeconomic uncertainty; instability; physical infrastructure (lack of basic services such as electricity or "old" communications technologies); institutional fragility; lack of social awareness about innovation; risk-averse nature of enterprises; lack of entrepreneurs; existence of barriers to business start-up; lack of public policy instruments for business support and management training". (OECD 2005, p. 136).

The Brazilian external organisational environment significantly interferes with both innovation and internationalisation processes and is thus considered to be a key negative determinant. All respondents stressed factors in the Brazilian external organisational environment that pose difficulties for these processes, such as the complexity of the legal system, which demands meticulous analysis on the part of managers, directors and the legal department (if any) of the relevant laws to be able to properly operate the business; the structure of the tax system, which is laborious to operationalise, requiring investments in a specialised department or the hiring of an outsourced firm to account for tax obligations, directly impacting the firm's competitiveness, as these surplus costs and taxes are levied on the final price of the product; the political system, which may undergo substantial transformations due to government changes (municipal, state and federal public administrations, which can change every four years), leading to possible instability and risks to business; and

the occurrence of national and international economic crises that affect the firms' overall performance. Ahmed and Brennan (2019) found that the export degree and scope of early internationalising firms, namely, international new ventures and born-global firms, are influenced by their founders' levels of international entrepreneurial orientation. This study also points out that the proactivity and risk-taking propensity of owners have positive effects on the export degree and scope of these firms. These two dimensions are particularly important in the context of less-developed countries, in this case, Bangladesh, which features weak and unstable institutions. Therefore, Brazil, like Bangladesh, also presents institutional barriers.

The next section presents the conclusions of the article. This section reiterates the theoretical findings and presents implications for managers and practitioners. This article closes by presenting research limitations and future research possibilities.

Concluding remarks

The general objective of this article is to analyse innovation as a determinant of the internationalisation patterns of Brazilian technology-based SMEs in different sectors and with different technological features. The main theoretical contribution of this article focuses on its analysis of incremental innovation development in products (goods) and radical innovation development in marketing as internationalisation determinants (Martínez-Román et al. 2019; Saridakis et al. 2019).

In terms of managerial implications, we highlight the intrafirm analysis of technological and nontechnological innovation development, describing how this process occurs in case firms and how innovation outputs determine internationalisation. Managers and practitioners must bear in mind the role of the external organisational environment (Teece et al., 1997), i.e. the Brazilian context, on the strategic planning of the firm, as this environment exerts influence on both the innovation and internationalisation processes. Consequently, public managers must pay close attention to the negative factors in the Brazilian external organisational environment that can undermine the innovation and internationalisation processes of case firms, and they must establish concrete legal solutions to solve the complexity of the legal and tax systems, which generates extra costs to firms, thus decreasing their competitiveness in national and international markets. The last public policy recommendation is the possibility of a continuing government project aiming to concretely promote economic growth through entrepreneurship, labour generation, productivity, and income improvement.

The limitations of the study are as follows. The first limitation concerns the restriction of the data used, as the available version of the online public database "List of Brazilian Exporting and Importing Companies" (*Lista de Empresas Brasileiras Exportadoras e Importadoras*) (Ministry of Economy 2022 [Ministério da Economia 2022]) presents different data than it contained during the entire period of the empirical study, which occurred from September 2014 to December 2015. The absence of the export value range for each exporting firm, which was originally included in the data for 2014, 2015, and 2016, does not currently allow for a complete explanation of the sampling process, specifically in terms of determining the

number of remaining firms in each research phase to then be able, in the final phase, to identify the number of case firms that should be part of the empirical study. This data restriction does not invalidate our research, as we were able to restructure the research design; instead, such a restriction reaffirms the importance of verifying data availability and reliability. Although this limitation is a critical data access restriction, there are no risks concerning research misconduct or issues with this article in terms of data display, as the article strictly employs data that is currently available online (Ministry of Economy 2022 [Ministério da Economia 2022]). The limitation concerning the research design is the result of the retrospective nature of the questions used in the interview guide pertaining to innovation and internationalisation. In terms of future research possibilities, this study can be replicated in the context of other emerging countries, as our understanding of innovation as an internationalisation determinant of technology-based SMEs in this context enables a macro comparative data analysis. There is also the possibility of replicating this research by including both mature and young technology-based SMEs in the sample. Future research can employ longitudinal data pertaining to case studies instead of data focusing on specific time points to broaden the period of observation of the innovation and internationalisation processes. The final proposal for future research is the validation of this qualitative study through a quantitative study, which can include a larger sample of technology-based SMEs.

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