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ORIGINAL ARTICLE

Frugal innovation in the expansion of a multinational subsidiary in an emerging market

Inovação frugal na expansão de subsidiária de multinacional em um mercado emergente

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Abstract: Frugal innovation consists of creating solutions based on the parsimonious use of resources with essential quality, design, and functionality, offered to customers with lower purchasing power. This study aims to analyze how a frugal innovation evolves in a multinational company during its expansion into a new market at the base of the pyramid (BoP). The adopted research strategy is a case study of a multinational subsidiary whose unit of analysis is the development of a frugal product from its inception to its presence in the market. A theoretical model that identifies the antecedents, processes, and results of frugal innovation supports data analysis. This study thus contributes establishing propositions that give specificity to the model with regard to the expansion of multinationals in an emerging market. The results reveal that strategy and brand consolidation precede the development of a frugal product, which is followed by systematic analysis of market characteristics, consumer behavior, and local competition. Additionally noteworthy are the horizontal integration and dynamic interaction of marketing and production; the adoption of a design that integrates basic functionalities, qualities, aesthetic attributes; and the minimal use of resources, the elimination of nonessential functionalities, the adoption of modularity as a production strategy, and the mastery of skills in production and learning strategies. Finally, the findings indicate the relevant combination and dynamization of organizational capabilities and their influence in reversing the technology transfer orientation between headquarters, as well as the consequences of frugal innovation.

Keywords: Frugal innovation; Product development; Emerging markets; BOP; Strategy.

Resumo: A inovação frugal consiste na criação de soluções baseada no uso parcimonioso de recursos, com qualidade, design e funcionalidades essenciais, oferecidos para clientes com menor poder aquisitivo. Este estudo tem como objetivo analisar como ocorre o desenvolvimento de uma inovação frugal em uma empresa multinacional, em fase de expansão de seus negócios em um mercado emergente da base da pirâmide. A estratégia de pesquisa adotada foi o estudo de caso da subsidiária de uma multinacional, em que a unidade de análise é o desenvolvimento de um produto frugal, desde sua concepção até a presença no mercado. A análise dos dados apoia-se em modelo teórico que identifica antecedentes, processos e resultados da inovação frugal. O estudo contribui com proposições que conferem especificidades a esse modelo para o

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contexto de expansão multinacionais em um mercado emergente. Os resultados revelam que a estratégia de expansão e consolidação de marca antecedem o desenvolvimento de um produto frugal, seguidas pela análise sistemática das características do mercado, comportamento do consumidor e concorrência local. Destacam-se também: a integração horizontal e interação dinâmica entre marketing e produção; a adoção de design que integre funcionalidades básicas, qualidade, atributos estéticos; uso mínimo de recursos; eliminação de funcionalidades não essenciais; adoção de modularidade como estratégia de produção; o domínio de capacidades em estratégias de produção e aprendizagem. Finalmente, os achados indicam a combinação e dinamização de capacidades organizacionais, bem como a influência na reversão da orientação de transferência de tecnologia entre matriz e subsidiária como consequências da inovação frugal.

Palavras-chave: Inovação frugal; Desenvolvimento de produto; Mercados emergentes; BoP; Estratégia.

1 Introduction

Frugal innovation is a topic with growing theoretical and applied interest and is related both to the analysis of characteristics of emerging markets at the base of the pyramid (BoP) and to new strategies in the development of products and services to serve these markets (Hossain, 2020). The concept of BoP emerged in the context of global poverty and amid the opportunity to reach new markets for companies, especially multinationals (Rosca et al., 2018). From the perspective of this concept, a new phase of growth in organizations is perceived through their service to markets where there is poverty, previously little considered by companies in their strategic plans. Thus, frugality is understood as a way to alleviate poverty and improve the quality of life in emerging countries (Prahalad, 2012). There is evidence that the BoP market represents a universe of approximately four billion people living with serious financial constraints, representing different cultures, ethnicities, literacy levels, skills and needs (Sarkar, 2018).

Frugal innovation has been studied from different perspectives, such as frugality as an innovation opportunity in emerging markets (e.g., Sarkar, 2018; Malik, 2017; Prahalad, 2012); frugality as a factor in economic development (e.g., Agarwal et al., 2020; Belkadi et al., 2018; Pisoni et al., 2018; Rosca et al., 2018; Simula et al., 2015); and frugality as a factor in environmental sustainability (e.g., Hossain, 2020; Koerich & Cancellier, 2019; Shibin et al., 2018). Frugal innovation is also considered a trend for innovation management because it contributes solutions for new markets and for environmental sustainability. Frugal innovation is developed from a resource constraint perspective, promoting quality products or services with design and essential functionality both for customers with modest lifestyles and to meet the needs of consumers with limited resources (Khan, 2016; Simula et al., 2015).

In this study, the perspective of frugal innovation as an internationalization opportunity for BoP-type markets is explored. The objective of this study is to analyze how frugal innovation occurs in a multinational company in the expansion phase of its business into BoP-type markets. Considering that the existing empirical studies on frugal innovation have a greater focus on China and India (e.g., Agarwal et al., 2020; Lim & Fujimoto, 2019; Sharmelly & Ray, 2018; Zeschky et al., 2011) amid the growth of new markets for local and international businesses (Gupta & Thomke, 2018), there is opportunity for a study in the Brazilian context. Thus, this study contributes to the understanding of frugal innovation in multinational companies, establishing propositions for understanding the focal phenomenon and providing both theoretical and applied contributions to studies on frugal innovation from the perspective of internationalization into emerging BoP markets.

Creating products or adapting existing ones to meet the specific needs of customers in emerging markets is a challenging issue that affects industry standards, technological resource use, maintaining low production costs and ensuring minimal environmental intervention (Agarwal et al., 2020). Examples of frugal innovation in the automotive industry are the 2CV vehicles from Citroën in France and the Tata Nano in India. These products were not designed to compete in a high-price niche but to beat competitors who offer products that have not met minimum quality requirements with a "suitable product" for scale production among low-income customers. These automakers offered simplified designs with low prices and acceptable performance levels, with significant changes in the cost-performance balance, achieved with the creation of new economic and technological properties (Lim & Fujimoto, 2019).

Although empirical studies provide an understanding of how new products derived from frugal innovation have positioned themselves in markets such as India and China (Agarwal et al., 2020; Lim & Fujimoto, 2019), there is a gap in the understanding of the process performed by multinationals in the introduction of a frugal product. The relevant local characteristics and resources need to be observed; in this sense, an exploration of the stages, mechanisms and organizational practices employed therein can contribute to the understanding of how frugal innovation occurs. To discuss the proposed problem, data from a case of product development with frugal characteristics, part of the business expansion strategy of a multinational company in Brazil, are explored.

The following sections present the theoretical foundation of the study and the adopted research method adopted, a description and analysis of the case, the propositions and some final considerations.

2 Theoretical foundations

The Indian word "jugaad" means "the art of overcoming severe restrictions, improvising effective solutions and using limited resources"; it is considered the precedent for the term frugal. "Jugaad" innovation involves the use of creativity and improvisation to make something existing more efficient or to create something new with few resources (Brem & Wolfram, 2014; Santos et al., 2020). Th historical roots of frugal innovation date to the ideas of appropriate technology by Schumacher (1973). Schumacher's ideas advocated against the large-scale, capital-intensive transfer of technology from high-income countries to low-income countries, as he considered this inadequate. Schumacher (1973) thus proposed a way to alleviate poverty and bring about the development of appropriate technologies, through intensive labor, which are simple to operate and repair, produced for low-income consumers on a small scale and with minimal harmful impact on the environment. Based on these ideas, frugal innovation emerged in the late 2000s as "technology appropriate for profit", emphasizing the role of the private sector. A major contributor to the development of the ideas and concepts of frugal innovation was Prahalad (2006), whose propositions for the potential of unexplored BoP markets drew the attention of multinationals (Rosca et al., 2018).

Frugal innovation has gained prominence as a strategy for BoP markets, or even for a segment of the population with better financial conditions that seeks frugal products, as there is a tendency to observe the use and waste of resources, which makes frugal innovation even more common and more relevant. To serve BoP markets, frugal innovation emerges as a new internationalization opportunity for these emerging markets, conferring a new role to multinational subsidiaries.

Multinational companies are increasingly replacing strategies involving the adoption by their subsidiaries of technologies developed in their parent company with the development of products/services based on local resources. Subsidiaries of multinationals in emerging markets are considered to have limited access to the resources of their parent company for research and development (R&D), marketing, coordination and systems integration. In addition, frugal innovation is a response to a set of restrictions, such as access to capital for investment in R&D, access to technological resources, access to foreign exchange and imports, or access to technologies and imported raw materials, relevant to the production and development process. In emerging markets, innovation strategies are also affected by the level of reliability of institutions and infrastructure, which can entail delays, interruptions or shortages. (Simula et al., 2015; Lin et al., 2020).

Mourtzis (2018) suggests that the application of frugal innovation in companies operating in emerging economies contributes to the adoption of practices of regionalization and customization. Thus, when operating in emerging markets, subsidiaries of multinational companies develop flexible operations and, as an adaptive response over time, create conditions for frugal innovation as an alternative to innovative capacity. These have become a source of low-cost strategies aimed at price-sensitive customers. The development of customer-oriented quality products at low prices through the use of efficient resources enables companies to expand markets and follow trends in consumer purchase behavior. Thus, subsidiaries invest in complementary technological capabilities for articulating and mobilizing innovations aligned with the markets in which they operate. Sometimes, this process can also represent a new strategy for knowledge and technology transfer between subsidiaries and parent companies through a new model of innovation architecture, given the relevant role of creation, as well as the transfer and exploitation of knowledge from operations (Malik, 2017; Pisoni et al., 2018).

An essential aspect of frugal innovation is a design focused on basic functionality with the development of solutions oriented to simplicity. Frugal innovation promotes a (re)design of products and services and is focused on reducing costs and simplifying production processes, as well as on small scales and adaptations to locally available resources. In this context, engineering is required to create simpler, lower-cost solutions, as well as solutions for design and manufacturing problems, given that the objective is to produce low-cost products/services with basic functionality rather than products that are very specific and difficult to acquire (Malik, 2017; Shibin et al., 2018; Pisoni et al., 2018; Hossain, 2020).

Specifically, with regard to the development of frugal products or services, an essential aspect to be considered is the alignment of processes that favor a price level that a less-favored population also considers affordable (Shibin et al., 2018). The development of frugal products or services requires management that aims to develop appropriate solutions that bring significant results compared to existing solutions for market needs, minimizing the use of resources such as energy, capital and time (Koerich & Cancellier, 2019). Thus, frugality can be achieved with the use of low-cost materials or low labor costs; it can also involve the elimination of functions that do not add value in the production process. Understanding how companies implement and benefit from the adoption of frugal approaches in emerging and developing countries has been one of the relevant aspects for frugal innovation, given that such multinationals are taking advantage of the potential of emerging markets, establishing local subsidiaries and developing frugal innovations (Agarwal et al., 2020).

Furthermore, frugality, as an opportunity for innovation, stands out due to its aspect of development in less-favored environments—through improvised solutions in the simplest possible way—since its greatest challenge is the ability of organizations to align processes and products to serve the focal population with fair prices and satisfactory quality, promoting a (re)design of products and services for these customers in emerging markets (Shibin et al., 2018; Pisoni et al., 2018).

In frugal innovation, engineering is required to create simpler solutions, whether at the level of product design or production strategy, by seeking solutions to design and manufacturing problems, given that the objective is to produce low-cost products or services with functionality rather than products with very specific features that are difficult to acquire (Malik, 2017). This article thus highlights the issue of modularity because it is a production strategy aimed at reducing complexity in product development with effects on cost reduction (Lau et al., 2011).

The modularity approach, as a production strategy, may be appropriate for the development of frugal products. Modularity consists of decomposing complex systems into independent but interconnected parts, which can be treated as conceptual, logical or physical units, as well as organizational units. Organizations that adopt modular design are able to create products faster than competitors that do not adopt this production strategy. By combining product modules, process modules and production capabilities, the development of a product for a new market can be achieved through a simultaneous adjustment of the design, production strategy and production network: a global solution. Thus, modularity allows the goals of frugality to be achieved and customers to be integrated into the order fulfillment process, providing sufficient flexibility to configure products at the right time (Belkadi et al., 2018; Lim & Fujimoto, 2019).

The concept of modularity refers to a production process with agility. Agility can be considered a new way of conducting the product life cycle, including design and manufacturing. It allows companies to quickly and flexibly respond to uncertain and unpredictable changes, requiring collaboration, the integration of customers in the development chain, the reuse of knowledge and speed in the configuration of products and processes (Mengoni et al., 2009).

In this study, for the analysis of the development process of frugal products/services, the Hossain model (2020) is used as the starting point (Figure 1) to establish the stages in the development of frugal innovations. The steps defined in the Hossain model (2020) are considered preliminary categories in the case analysis, as discussed below. Specifically, Hossain (2020) proposes a model that defines the relevant antecedents, processes and results. In this model, the antecedents of frugal innovation are segmented into three dimensions: triggers, motivation and initiatives. This background allows experiments with several frugal innovations, entailing the search for solutions to meet the personal and social needs of different elements (cultures, ethnicities, religion). Experiments start with entrepreneurs testing their ideas; as soon as they realize their potential, they involve many difficult decisions and the ability of entrepreneurs to turn an idea into a viable product. The diffusion of frugal products differs from conventional products because they are first introduced in a basic market (which is often a local market) and then extended to other markets. The results of frugal products may also be different compared to conventional products. These products are sustainable and resource efficient and create a market for new customers with a new type of product, in addition to being accessible to customers who cannot pay for equivalent conventional products (Hossain, 2020).

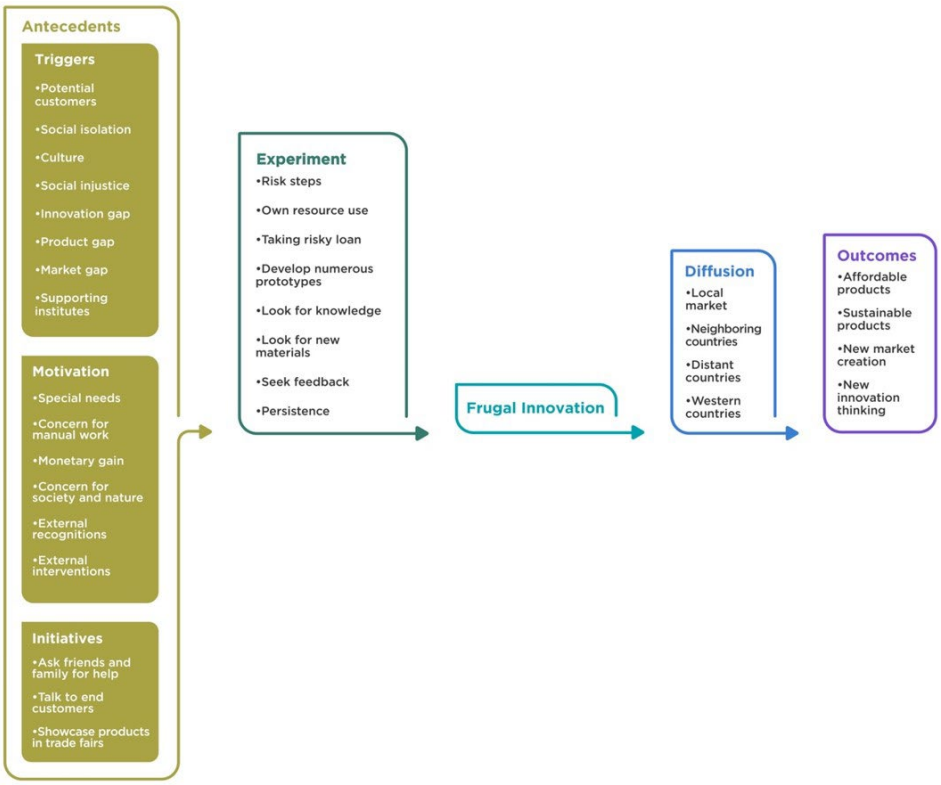

Figure 1. Antecedents, processes and outcomes of frugal innovation.
Source: Hossain (2020).

The following section describes the research strategy and methodological procedures.

3 Method

The adopted research strategy in this study was a case study, specifically, of a subsidiary of a multinational, and the unit of analysis was the development of a frugal product. The case study approach was chosen due to the inductive nature of this study, which aims to contribute to the establishment of propositions for the understanding of a phenomenon. Regarding the choice of case, we sought a company that had developed a product with characteristics of frugality. Thus, a *joint venture* of Chinese and American origin established in Brazil was identified whose focus is on the refrigeration and home appliance business. This company has sought to expand its operations in the Brazilian market by launching new products. It is an innovation-driven and technology-oriented multinational with an increasing focus on emerging markets, thus defining itself as an appropriate case for this study.

In this case study, primary and secondary data such as documents, interviews, questionnaires and observations were used to triangulate these different sources of evidence (Eisenhardt, 1989; Yin, 2015). Data collection began in January 2021 and ended in May 2021, performed in two stages. The first focused on the identification and exploitation of secondary data. The second involved the collection of primary data.

The primary data were obtained through interviews with leaders and technical experts of the company from different areas involved in the product development process, such as procurement, international logistics, product engineering, product marketing, commercial/sales and industrial management, to understand the processes, strategies and other business definitions. In Table 1 in the appendix, the characterizations of the interviewees are listed.

Table 1. Characterizations of interviewees.

Code	Function	Gender	Date of interview	Interview time (h)	Modality
E1	Supplies Manager	Female	05/feb/2021	1:45 h	In-person
E2	International Logistics Coordinator	Female	05/mar/2021	0:58 h	In-person
E3	Product Engineering Analyst	Male	11/mar/2021	1:09 h	Online
E4	Product Engineering Coordinator	Male	16/apr/2021	1:03 h	Online
E5	Product Marketing Manager Latin America	Male	12/mar/2021	1:26 h	Online
E6	National Sales Manager	Male	23/mar/2021	0:57 h	Online
E7	Industrial Director	Male	23/mar/2021	1:32 h	Online
E8	Supply Chain Coordinator	Female	09/apr/2021	0:46 h	Online

Source: Research data.

The interviews were conducted based on a semistructured script that considered the preliminary categories of the analysis model. In all, there were 8 interviews, recorded with the consent of the interviewees, which totaled 9 hours and 42 minutes and 70 pages of transcription. Additionally, 25 documents provided by the company were analyzed. These documents provide evidence of the focal project in the case study, from its inception in 2013 to its completion in 2020, when the company began to discontinue the current line and launched a new microwave model that met new requirements, i.e., public needs and wants in terms of quality, design and cost.

ATLAS.ti® software was used as a support tool during content analysis. The adopted theoretical model was used for the preliminary categorization of the data, adding inductive categories based on the evidence identified in the field (Moraes, 1999). Below, the investigated case is described and discussed.

4 The case of a new microwave oven for the Brazilian market

The expansion of its home appliance brand in the Brazilian market was a strategic objective of the focal Sino-American multinational. For this, a new product was developed for local production, whose target audience was the low-income market. This company is the result of the merger of two multinationals, one of Chinese origin, a leader in the production of home appliances, and the other of American origin, a leader in the air conditioning industry.

In 2011, the two companies formed a joint venture to produce and distribute products in Brazil, Argentina and Chile, thus becoming the largest manufacturers of air conditioning equipment in Latin America. The company has an R&D center in Brazil, which is responsible for launching new technologies for the products of the brands marketed by the company. There is thus a focus on product innovation, quality, and cost control and an orientation toward environmental sustainability.

The project for the development and production of a microwave oven emerged due to the interest of the Chinese parent company in expanding its business in Brazil and its practice in home appliance retail, usually offering a mix of products from the same brand. Hence, in addition to the products already offered by the company, this microwave would be an additional item in the portfolio of the company that had already produced a refrigeration line in the Brazilian market (Data from interviewees E3, E5 and E6).

Regarding the development of the new microwave, a set of steps was observed, following a project management procedure developed by the company. This procedure aims to direct the R&D of products or improvements to meet or exceed customer expectations. This procedure details the stages of a project, as well as the applicable tools for verification and validation based on their level of complexity.

An R&D project in the company begins when a market opportunity, quality improvement or cost reduction is envisioned. The microwave project was driven by the company's brand internationalization strategy. The production of home appliances in Brazil was already part of the brand's internationalization strategy, given the seasonality of products related to refrigeration, providing opportunities for the expansion of its business in the production of home appliances.

In this company, in the development of products, the project management procedure has six distinct stages. It starts with "Stage 0", called the *Quality Review Board* (QRB), which has a technical nature and aims to evaluate project information (concepts, test results, pricing strategies, qualification plans, etc.). A lack of knowledge about the production process of microwave ovens made this project more challenging, precisely because of the company's need to adapt the expertise of the Chinese matrix to the Brazilian context, both in terms of the production process and the market, whose specific characteristics were related to product attributes and price. In this stage, to define the attributes of the product, the company conducted a survey in Brazil with the prototype of a 30-liter microwave oven, compared it with two models of competing brands. The result of this study was the low acceptance of the model that had been created. Only 11% of consumers in the surveyed sample opted for the exposed model, which generated the need to reevaluate the attributes of the product to be produced. After three months, with a new design for the 30-liter product, a visual survey was conducted, again with consumers and three other competitor models. The result was positive for public acceptance. With a 61% preference, the model was approved by consumers. Compared to the manufacturer with the highest score on the first survey, the product obtained a 70% preference. Notably, the main competitor also had a 42% market share in the Brazilian market. The model with a white mirrored glass door proved to be an interesting product because it achieved a 65% preference in Class C compared to competitors. According to the comments of the consumers participating in this study, white matches the standard kitchen among them, which is also predominantly white, but offers a different feature: the mirror effect. Similar to the 30-liter model, the 20-liter model also obtained a preference of 70% over competitor B. Based on the result of the survey on product design, five microwave models of 20, 25 and 30 liters were adopted.

Additionally, in "Stage 0", once the product attributes are defined, pricing must occur to support managers in their decision on the feasibility or sustainability of a project. The suggested sales price is prepared together with a benchmark of the most relevant products in the Brazilian market. In the case of the microwaves, the 20- and 25-liter concepts were positioned with a value lower than their main competitors by approximately 9%. For the 30-liter product, a competitive price was charged to meet the public policy of the federal government of R$ 350.00 (three hundred and fifty reais)

called “Minha casa Melhor”. This was created in 2013 to help the consumer beneficiaries of this policy acquire furniture for their new house or apartment by paying affordable installments (Brasil, 2020). Figures 2 and 3 illustrate the case’s market position compared to its competitors.

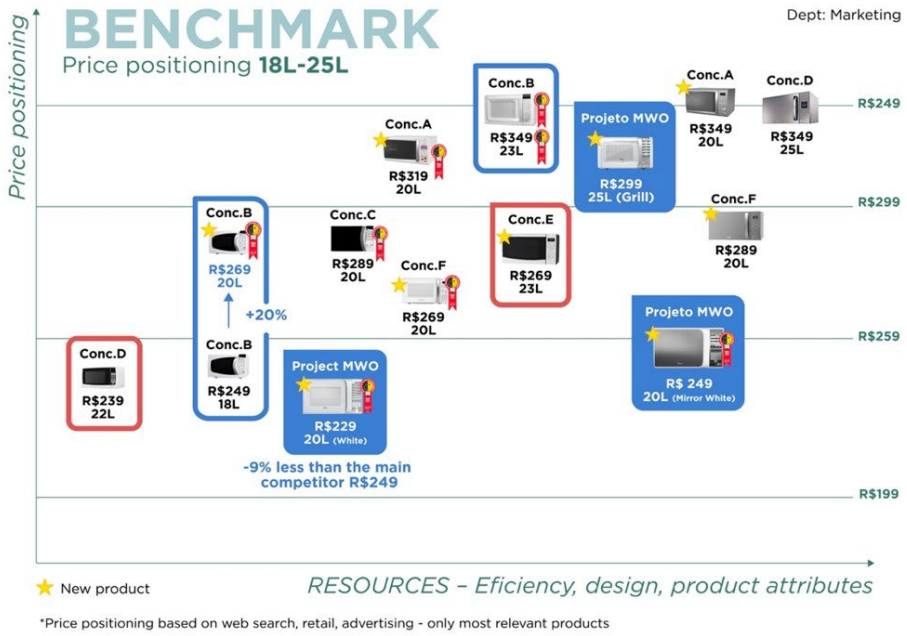

Figure 2. Price positioning of microwaves 18–25 liters.
Source: Adapted by the authors from internal documents provided by the company.

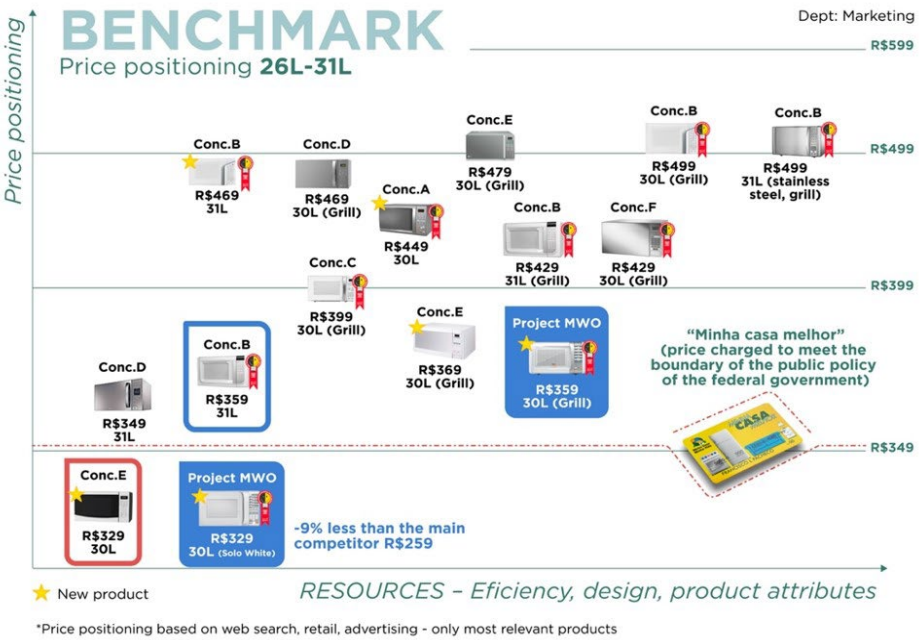

Figure 3. Price positioning of microwaves 26–31 liters.
Source: Adapted by the authors from internal documents provided by the company.

Next, “Stage 1” includes the technological feasibility and other definitions necessary for the development of a project. This stage includes the first tests of functional prototypes, the preparation of qualification and reliability plans, and the first decisions made regarding manufacturing and supplier selection. In “Stage 2”, the event “Design Freeze QRB” takes place, which brings together a management committee in the company of a technical nature to deliberate on meeting the technical requirements of the project and recommend (or not) the passage to the next stage. At this point, reliability tests of the product and its respective components are conducted. In “Stage 3”, special attention is given to the quality and reliability of the manufacturing and logistics processes, which are evaluated by holding events at the manufacturing level such as the “Manufacturing Check Sample (MCS)”, where the product is assembled to validate the production line, manufacture of its components, a review of the purchasing process and associated industrial planning. Then, the pilot line takes place, which is the assembly of the first batch, in which any nonconformities and opportunities for improvement that must be addressed are identified and rectified before product launch. In “Stage 4”, items such as the results of the manufacturing and logistics qualifications, final product costs and reliability test results (such as component life tests or field tests) are evaluated, as well as any pending issues related to the project. Finally, in “Stage 5”, production begins, the project team is disbanded, and the members are directed to other projects. The product then becomes part of the company’s product base and, thus, follows the routines related to product engineering, becoming an object for quality improvement and/or cost reduction projects. Based on the results of these steps, it is possible to confirm the development of a frugal product, opening possibilities for the creation of new products.

5 Analysis and propositions for the development of a frugal product and expansion into a new market

Figure 4 summarizes the propositions established in this study, based on the antecedents, processes and results of frugal innovation. These propositions are discussed below.

This analysis of the case of a new model of microwave oven for the Brazilian market allowed the formulation of propositions about frugal innovation in the context of the expansion of a multinational company into a BoP market. These propositions depart from the preliminary categories “background, processes and results” in the data analysis in this study and are inspired by Hossain’s (2020) model (Figure 1) of frugal innovation. This model is not exclusive to a focus on the expansion of the operations of multinationals. From this perspective, the propositions, by combining the categories of Hossain (2020) with the research evidence, confer specificity to this model for a focus on the expansion of multinationals in BoP markets. Below, some aspects of the antecedents, processes and results of the case in question are discussed to establish some propositions for future studies and elaborate on certain managerial implications.

The company aimed to expand its brand in the emerging Brazilian market by launching new products; it sought a high-volume market segment that was aligned with its strategies for expanding its product portfolio. It is, therefore, a business built on opportunities for innovation and expansions of product and market, which represent the triggers for the development of a frugal product. In particular, survey data on consumer behavior and feedback from retail partners preceded the focal business idea, providing guidance on which characteristics should be prioritized in any new products,

taking into account consumers' available budgets (Interviewee E5). This understanding can be perceived in the words of interviewee E2, which explain the company's intention to make the brand known by using, as an entry strategy, the offer of a more affordable product line to win the largest possible share of consumers interested in price and quality with any specific brand prerequisite. In this sense, the case is in line with Malik's (2017) study on the internationalization of multinational companies in emerging markets, whose specific characteristics imply a series of adaptations that can give rise to frugal innovation. In the focal case, its internationalization strategy occurred through its industrial expansion into Brazil, a bet on the development of the adequate operations of products for the emerging Brazilian market. The microwave production project was the entry point for the brand in the home appliance industry in Brazil, with the local production of a product of high accessibility for homes in the Brazilian market and high volume. The company was aware that this was a product with difficult to attain profitability due to its low added value and because it is a well-established product among the companies that already produce it. At the time, it was believed that the microwave brand would be leveraged together with the air conditioning products, a strategy for a "surname brand" together with the already consolidated brand in Brazil, precisely so that the consumers would link them (Interviewee E3). This evidence, identified in the focal case, leads to the first proposition derived from this study:

> *P1: In multinational companies, the development of frugal products for BoP markets is preceded by a strategy of expansion and brand consolidation.*

The focal case of the microwave oven also suggests that the development of frugal products follows project management standards according to a company's existing R&D and technological capabilities, in alignment with marketing and production. Thus, the development of a new product starts with research on the market, consumer behavior and the structure of competition. Data on the local market, consumer behavior and the perceptions of retail partners are essential for a project to provide guidance on which characteristics should be prioritized in any new products (Interviewee E5).

Hossain (2020) indicates that experiments with the objective of researching consumers, identifying their personal and social needs, which end up being transformed into products and, thus, expand the target market, are the antecedents of frugal businesses. In this study, the case of microwaves reveals both horizontal integration of and dynamic interaction between marketing and production. Hence, market, consumer and competition research is already part of the product development process. In this regard, the second proposition of this study is established as follows:

> *P2: The development of a frugal product depends on the systematic analysis of market characteristics, consumer behavior, and local competition, as well as on dynamic interaction between marketing and production.*

In the development of a frugal product, it is necessary to create value by doing more with less, that is, by reducing the use of resources such as energy, capital and time (Khan, 2016). From this perspective, the focal company determined the manufacturing, material and design costs that best met the requirements for its new products destined for the Brazilian market and combined these with the simplicity, basic functionality and minimum of features to meet customers' needs and desires in terms of functionality and aesthetics, providing the accessibility and quality they require for such products (Hyvärinen et al., 2016). Another aspect related to the processes in the development

of frugality is the possibility of eliminating functions that do not add value to the production process (Hossain, 2020). Along these lines, the company explored some possibilities, both in the production process and in the product itself. In this case of microwaves, their power functionality was redesigned; this is an available resource but is not commonly used by consumers, as mentioned by interviewee E5. Another example of household appliances cited by respondents was the focal company's oil-free deep fryer, where it was possible to achieve a 20% reduction in the final price through some adjustments, such as the elimination of the temperature control feature, which is not considered a relevant feature by consumers (Interviewee E5). In line with these considerations, propositions 3a and 3b are as follows:

> *P3a: The development of frugal products is related to a design that integrates basic functionality, quality, aesthetic attributes and a minimal use of resources.*
>
> *P3b: The elimination of nonessential features favors the development of frugal products.*

In the production process, modularity is also used as a strategy to reduce the use of resources and control costs. To speed up a production process, the concept of modularity is adopted as a new way of conducting the product life cycle, including design and manufacturing, in addition to foster speed in the configuration of products and processes (Belkadi et al., 2018; Lau et al., 2011; Mengoni et al., 2009). Modularity allows the decomposition of complex systems into independent but interconnected parts, enabling the creation of new products faster than competitors who do not use this strategy, acting as a facilitator of frugality due to the flexibility to configure products at the right time.. In the present case, the company has applied the concept of modularity in its production process, not only for the focal microwave but also in the production of air conditioning, as it allows resource savings and greater production flexibility. As noted by interviewee E5, for the sustainability of the business, it is impossible to develop a specific tool for each product. Accordingly, proposition 4 is as follows:

> *P4: The adoption of modularity as a production strategy favors the development of frugal products.*

The focal case of microwaves also reveals how "doing more with less" can overcome the limitations of financial, material or institutional resources and transform them into advantages, enabling consolidated and standardized routines. This allows an objective analysis of process optimization. The company has employed many cost reduction programs in addition to evaluating the structural aspects of components, suppliers, assemblies and test stages, among other parts of the process, thereby achieving a reduction of 15% to 18% in the total labor on the production line—approximately 30% of the cost of the product, a very significant result (Interviewees E4 and E7). These identified aspects suggest that the design of a frugal product is based on productive and learning capabilities, as indicated by Belkadi et al. (2018) and Lau et al. (2011). In this regard, proposition 5 is as follows:

> *P5: The development of frugal products is favored by skills in production and learning strategies.*

In the focal case, the development of a frugal product corresponded to a strategy of publicizing the brand in the Brazilian market, as well as to its consequent expansion in the commercialization of new products. This was confirmed by its gain in market share and expansion of its range of products commercialized in the Brazilian market, as stated by interviewees E4 and E6. The evidence in this case therefore suggests that the development of a frugal product implies a dynamic that combines the knowledge of a parent company with the knowledge creation processes in its subsidiary. Thus, there is both the transfer of knowledge from the parent company to the subsidiary as well as the dissemination of knowledge from the subsidiary to the parent company and other subsidiaries. One example of transfer of knowledge from subsidiary to subsidiary is the model of a condenser developed in Brazil and later produced in India (Interviewees E1, E2, E3, E4 and E5).

Figure 4. Propositions on the development of frugal products in multinationals in emerging markets.
Source: Established by the authors.

The evidence in this study thus reinforces the understanding that the role of subsidiaries of multinational companies extends beyond the adoption of technologies developed in their parent company. The development of frugal products highlights the relevance of investing in local capabilities to leverage sustainable competitive advantage. The focal case also reinforces the understanding of the resignification of the innovation architecture, in which the transfer and exploitation of knowledge has been increasingly widespread in global operations, whereby organizations seek to train subsidiaries not only in production capacity but also in R&D (Pisoni et al., 2018). Accordingly, propositions 6a and 6b are presented as follows:

> *P6a: The development of a frugal product in a multinational company entails the combination and dynamization of the capabilities of the parent company and its subsidiary.*
>
> *P6b: The development of a frugal product is related to the reversal of the usual orientation of technology transfer between parent company and subsidiary.*

6 Final considerations

The objective of this study is to analyze how frugal innovation occurs in a multinational company in the expansion phase of its business into a BoP-type market.

The central elements of the theoretical foundation focus on the perspective of frugality, i.e., an opportunity for innovation in emerging BoP markets, a universe with ample possibility for exploitation in terms of investment and development.

This study, which analyzes a Brazilian case, is in line with other empirical studies in different contexts where frugal innovation is part of a strategy for local and international business growth (e.g., Agarwal et al., 2020; Lim & Fujimoto, 2019; Sharmelly & Ray, 2018; Zeschky et al., 2011). Previous studies on frugality in the context of emerging markets have been considered; based on these studies, especially Hossain (2020), preliminary categories have been established for frugal project analysis: antecedents, processes and results.

The analysis of the development of a frugal product was conducted through a case study of a multinational located in Brazil, a joint venture of Chinese and American origin operating in the fields of refrigeration and household appliances. The case proved to be salient to this research, as the company was in its expansion and exploration phase of the Brazilian market. The focus of analysis was a specific product, which represented an innovation for the company through the local production thereof—a microwave oven. This case represented a congruent relationship between the theoretical and empirical fields and allowed the induction of propositions, covering the antecedents, processes and results concerning the development of frugal products.

This study contributes to the literature by proposing that in the context of multinationals operating in emerging markets, the antecedent to the development of a frugal product is the strategy of expansion and brand consolidation. Regarding the development of a frugal product, the systematic analysis demonstrates that market characteristics, consumer behavior, and local competition amid a horizontal integration and dynamic interaction between marketing and production stand out as the explanatory factors; that its design must integrate basic functionality, quality, aesthetic attributes and a minimal use of resources; that nonessential functionalities must be eliminated; that modularity must be adopted as a production strategy; that a coherent customization of products is necessary; and that there is a requisite mastery of skills in production and learning strategies. The result of the development of a frugal product, the focal data have allowed us to highlight the combination and dynamism of capabilities, its influence on the reversal of the orientation of technology transfer between parent company and subsidiary and the relevant aspects of changes in economic conditions, technologies and customer needs.

From an applied perspective, this study has implications for managers in multinationals or local companies, as it sheds light on the opportunities for creating new products and, as a result, for businesses in emerging markets, such as Brazil. Regarding project management, the results have implications for different areas, such as marketing, management and business, R&D and operations, since the evolution of any project is directly related to the interaction of various areas in a company.

Regarding this study's limitations, the above propositions derived from the data tend to be more applicable in industrial sectors similar to the focal case. Thus, the findings are more relevant to products in traditional industries. In this sense, case studies on technology-intensive services would be opportunities to compare the above propositions with other types of products and/or services. Evaluating frugal product development from the perspective of a small or medium-sized company may also generate new findings.

For future studies, it is suggested that the propositions in this study be converted into hypotheses that can be tested, with a view toward establishing a model for frugal innovation.

Notably, in future studies, the development of frugal products should also be investigated from the perspective of sustainability, considering its growing importance in the social and environmental context, entailing a deepening importance of issues related to the circular economy. In this regard, this study, which was conducted in the context of the COVID-19 pandemic, can motivate people to assign new meanings and priorities to behaviors and create new habits, in both domestic and professional contexts. From this perspective, in addition to the opportunities it offers for business expansion into new markets, frugality seems to impose itself as a lifestyle and a consumption style.

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Authors contribution

Maísa Arend and Yeda Swirski de Souza were responsible for conceptualization, development of the theoretical-methodological approach, data analysis, propositions and for the writing and revision of the manuscript. Cláudia Felippe Ramos worked on the writing and final revision of the manuscript.