

Technological Article

Frugal Innovation and Sustainability in the Footwear Sector

Inovação Frugal e Sustentabilidade no Setor Calçadista



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ABSTRACT

Objective: this article aims to analyze how footwear companies can innovate frugally in convergence with the principles of sustainability. This objective was achieved based on studies that observe the relationship between sustainability and frugal innovation, with an emphasis on bricolage strategies, from a perspective of applicability in the footwear industry, as it is a sector with high environmental impact. **Method:** the research uses design science research, and made use of a field diary, for greater depth of understanding of the footwear environment, as well as secondary analysis of documents on the internet and transcribed interviews with the seven experts. **Results:** the study managed to propose two action artifacts, one of them a frugal and sustainable sneaker artifact, and, as a second action artifact, it realized the need for collaborative and constant action between universities and companies in the search for frugal and sustainable solutions, which can benefit both companies, through profitable results, and the university, through longitudinal research and production of articles. **Conclusions:** the footwear industry yearns for low-cost (frugal) innovations that are at the same time sustainable, and demonstrates capacity and interest in meeting social and political demands for sustainable actions; in order to achieve this, greater proximity to the university presents itself as a collaboration that can produce benefits for both, with side effects of positive impact on environmental initiatives, society, and government policies.

Keywords: bricolage; frugal sneakers; university and business collaboration; artifacts; footwear industry.

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RESUMO

Objetivo: analisar como as empresas de calçados podem inovar de maneira frugal em convergência com os princípios da sustentabilidade. Tal objetivo foi realizado com base em estudos que observam a relação entre a sustentabilidade e a inovação frugal, com ênfase em estratégias de bricolagem, sob uma perspectiva de aplicabilidade na indústria calçadista, por ser um setor de alto impacto ambiental. **Método:** a pesquisa faz uso do *design science research*. Para a coleta de dados se fez uso de diário de campo, para maior aprofundamento de compreensão do ambiente calçadista, além de análise secundária de documentos na internet e entrevistas. **Resultados:** o estudo propôs dois artefatos, um deles um artefato de tênis frugal e sustentável e, como segundo artefato de ação, também percebeu a necessidade da atuação colaborativa e constante entre universidade e empresas na busca por soluções frugais e sustentáveis, que possam beneficiar tanto as empresas, por meio de resultados lucrativos, quanto a universidade, por meio de pesquisas longitudinais e produção de artigos. **Conclusões:** a indústria calçadista anseia por inovações de baixo custo (frugais) e que sejam ao mesmo tempo sustentáveis, demonstrando capacidade e interesse em atender às demandas sociais e políticas por ações sustentáveis; para isso, uma maior proximidade com a universidade se apresenta como uma colaboração que pode produzir benefícios para ambos, com efeitos colaterais de impacto positivo para iniciativas ambientais, sociedade e políticas governamentais.

Palavras-chave: bricolagem; tênis frugal; colaboração universidade e empresas; artefatos; indústria calçadista.

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INTRODUCTION

The term ‘frugal innovation’ is characterized by the ability of innovators to find solutions to social problems, usually through bricolage, which refers to solving challenges using available resources, without the need to purchase new raw materials (Soni & Krishnan, 2014; Weyrauch & Herstatt, 2017). Because of that, frugal innovation has become known as the ability to ‘do more with less’ (Bhatti et al., 2013; Radjou & Prabhu, 2015; Sarkar & Mateus, 2022), thus contributing to sustainability issues.

With an annual production on a global scale of approximately 23 billion pairs of shoes (Statista, 2022), the footwear industry provides the opportunity for a study that aims to analyze the environmental impact of companies from the perspective of sustainability dimensions (Elkington, 1994; Kuhlman & Farrington, 2010), and what role frugal innovation can play in the search for solutions that promote a change in mentality (Radjou & Prabhu, 2015; Soni & Krishnan, 2014) for frugal innovation in convergence with sustainability.

Therefore, the research problem that this study aims to investigate is: How can footwear companies innovate frugally in convergence with the principles of sustainability? The objective is to analyze how frugal innovation can be applied in footwear companies in line with the principles of sustainability. In order to understand how sustainability and frugal innovation can be applied to the reality of companies, this research starts from a problem of leftover materials in the production process in footwear companies located in the Vale dos Sinos region, Rio Grande do Sul, in a work which involved the participation of seven footwear experts through a design science research (DSR) study, which aims to empirically solve problems based on academic theories (Dresch et al., 2015; Lacerda et al., 2013; Vaishnavi & Kuechler, 2021).

The research contributed to the presentation of two proposed artifacts: (a) a frugal and sustainable sneaker, with a colorful and innovative design that uses leftover fabrics (textile) from production; and (b) a method for developing frugal and sustainable innovation in partnership between companies and universities.

Therefore, it is understood that industries, in particular the footwear industry presented in this research, have interest in frugal innovations that are at the same time sustainable. That being so, revealing the process of developing a product in close proximity to the university presents itself as a condition that can produce benefits for

both, with side effects of positive impact on environmental initiatives, society, and government policies.

THEORETICAL FOUNDATION

With the advent of the Industrial Revolution and its mass production capacity, thinkers started warning about the effects of the negative impacts of human and productive action on the environment, actions that put at risk the possibility of human life on the planet in the posterity, and such concern led to the development of the concept of sustainability (Albert, 2022; Kuhlman & Farrington, 2010; Schumacher, 1973).

Given the understanding of the importance of the topic of sustainability, its definition has gained both depth and refinement that helps understand the role of the actors involved and to find more objective ways of measuring the results achieved in the search for improvements, as is the case with the triple bottom line (tripod of sustainability) by Elkington: environmental, social, and economic (Elkington, 1994; Hossain, 2021b; Kuhlman & Farrington, 2010; Stöber et al., 2022). World governments, aware of the need to create more effective practical measures, in a joint effort, established the 17 objectives for sustainable development (Sustainable Development Goals) in 2015, with a deadline to be met by 2030. Among the actions are examples such as the elimination of poverty, the eradication of hunger, focus on quality of life and health, responsible consumption and production, etc. (Albert, 2022; Hossain, 2021b; Stöber et al., 2022).

More recently, authors began to pay attention to the fact that frugal innovation could present itself as part of the solution in the search for results aimed at sustainability. Bhatti et al. (2013), Rao (2013) and Radjou and Prabhu (2015) had already pointed to the possibility of frugal innovation presenting sustainability characteristics. However, in the study by Weyrauch and Herstatt (2017) this relationship was not conclusively confirmed, inviting researchers to delve deeper into the topic. Frugal innovation is a phenomenon that described, initially, the culture of innovation in India, coined by Navi Radjou as the ability to ‘do more with less,’ due to its ability to provide solutions with low production costs and low purchase price for consumers at the base of the pyramid, in situations of extreme poverty (Bhatti et al., 2013; Onsongo et al., 2023; Prahalad & Hart, 2002; Radjou & Prabhu, 2015; Sarkar & Mateus, 2022).

The term ‘frugal innovation’ is still recent, having gained visibility mainly in 2010, with the publication of an

article in *The Economist magazine* (2010) on this topic and, therefore, still presents difficulties regarding its definition and possible applicability (Sarkar & Mateus, 2022). As an attempt to elucidate the concept, researchers Weyrauch and Herstatt (2017) proposed a study with a systematic literature review and interviews with experts (entrepreneurs and researchers) to try to identify a tool for measuring frugal innovation. The authors concluded that frugal innovation can be defined based on three fundamental parameters, which are: (1) substantial cost reduction; (2) concentration on core functionalities; and (3) optimized level of performance. Other authors, such as Schleinkofer et al. (2019), Hossain (2021a), Reina et al. (2021) and Hossain et al. (2022), also agree with that proposition.

Weyrauch and Herstatt (2017) proposed a reduction of at least 30% in the final sales price in relation to other qualitatively similar and competing products. For the same authors, in line with the literature on frugal innovation, it is essential that this price reduction is perceived by the end customer (Sheikh et al., 2023). This characteristic of being able to innovate, even in situations of restriction and limitation, reveals the ability to transform adversity into a competitive advantage, encouraging companies to be more efficient in the use and reuse of financial and material resources (Asakawa et al., 2019; Rao, 2017). Costs can be further reduced when the raw materials used come from local suppliers, or are recycled materials or materials that would otherwise be discarded by the companies themselves (Busch et al., 2018; Hossain, 2021b). Thus, they represent a characteristic of frugal innovation called bricolage, which is the ability to innovate using available materials, without acquiring new resources (Agarwal et al., 2017; Bhatti et al., 2018).

Based on recent systematic reviews that analyzed the relationship between frugal innovation and sustainability, it was observed that there is, in fact, a possible relationship between the two themes and that frugal innovation can serve as an innovation path that promotes sustainability (Albert, 2022; De Marchi et al., 2022; Shahid et al., 2023; Silva et al., 2022; Stöber et al., 2022). However, it is important to highlight that, if the intention for sustainability is not observed through the practice of frugal innovation, undesirable results may be produced. Warnings and criticisms have been made in this regard (Hossain, 2021b; Hossain et al., 2022; McMurray et al., 2019; Meagher, 2017; Pansera, 2018).

One of the problems observed is that by offering products of very low price, frugal innovation can precisely cause environmental problems by promoting consumerism

and accumulation, problems caused by the possibility of scalability of this innovation, and which studies on sustainability precisely seek to combat (Hossain, 2021b; Hossain et al., 2022). Gandenberger et al. (2020) argue that global consumption will increase anyway, and that this is not a problem that should be attributed to frugal innovation. In fact, frugal innovation would be a strategy to help reduce the unwanted impacts of scalability (Stöber et al., 2022).

Frugal innovation presents the characteristics to initiate a dialogue with different social actors (society, companies, universities, and governments) in the search for solutions that take into account companies' needs for profit without ignoring social, political, and ecological concerns (Albert, 2022; Radjou & Prabhu, 2015; Reina et al., 2021; Stöber et al., 2022). In order for companies to understand the importance of attention that needs to be given to production methods and the offering of products and services that take into account social, environmental, and economic problems, a change in the way of thinking (mindset) is necessary and in the way of understanding innovation so that it is not limited to company boundaries (Soni & Krishnan, 2014; Weyrauch & Herstatt, 2017).

The global footwear industry produces around 23 billion pairs of shoes per year, which means a quantity of around three pairs of shoes per inhabitant of the planet, considering a total world population of approximately eight billion people (Pacheco-Blanco et al., 2018; Statista, 2022; Ted-Ed, 2020). These numbers represent the impact and responsibility of the footwear industry in terms of sustainability, that is, the potential of this industry in developing sustainable actions and proposing awareness campaigns to consumers (Pacheco-Blanco et al., 2018; Polese et al., 2019; Ted-Ed, 2020).

METHODOLOGICAL PROCEDURES

This research is guided by the design science research (DSR) method (Dresch et al., 2015; Lacerda et al., 2013) and follows the guidelines of the DSR model by Vaishnavi and Kuechler (2021), in which the construction of the research artifact takes place in five stages: (1) definition of the problem; (2) suggestion; (3) development; (4) evaluation; and (5) conclusion. The presentation of this last stage, stage 5, the conclusion, follows the definitions of March and Smith (1995), for the characterization of the artifact, which in this study presents two results (artifacts), which are: the instantiation and the method proposed. Table 1 illustrates the research steps.

Table 1. Research steps.

<i>Design Science Research Steps</i>		
DSR Process Step	Activity Developed	Date
1. Problem identification: waste of materials with financial loss	> Unstructured interview with experts and field diary. > Literature review on frugal innovation and sustainability.	Between 05/15/2023 and 08/02/2023
2. Suggestion: create a frugal and sustainable sneaker that absorbs material and financial losses	> Unstructured interview with experts and field diary. > Analysis of secondary data on internet pages, videos on YouTube, and Instagram about strategies of frugal and sustainable sneaker brands.	Between 05/15/2023 and 07/04/2023
3. Development: study of costs and processes with experts	> Unstructured interview with experts, field diary, and cost analysis. > Field visit to museums and footwear companies and participation in innovation events. > Presentation of the artifact (sneaker) to experts.	Between 06/20/2023 and 07/04/2023
4. Assessment: interviews with experts	> Structured interview with experts to evaluate the tennis artifact and the tennis development method. > Content analysis of interview transcripts.	Between 07/04/2023 and 08/02/2023
5. Conclusion: results presented in academic article format	> Presentation of research results through the artifact that is a sneaker developed based on frugal and sustainable innovation (INSTANTIATION). > Presentation of the results of the interview with experts and the frugal and sustainable innovation development artifact (METHOD).	11/15/2023

Note. Source: Developed by the authors.

In the first stage, in which the research problem in footwear companies was identified, an initial approach (unstructured interview) was carried out with seven experts and a field diary was kept to gather initial information to proceed with the research (Yin, 2016). This first approach with experts identified the problem of waste of fabric raw materials used in the upper part of shoes in the production process. The leftover fabric is resold as scrap at a price well below the initial purchase value, or, in some cases, companies pay for other recycling companies to collect and dispose of the material. In addition, as part of the problem identification process, the theoretical framework was consulted, focusing mainly on five systematic reviews of the literature on frugal innovation and sustainability: Iqbal et al. (2021), Albert (2022), De Marchi et al. (2022), Silva et al. (2022) and Stöber et al. (2022).

The second stage refers to the moment of suggesting a possible solution to the waste problem, in which it was proposed to create a frugal and sustainable sneaker by reusing material that would be discarded with financial loss. At this stage, unstructured interviews were deepened, which took place via the Microsoft Teams application, and with visits to companies to feed the field diary about the tennis proposal, with experts compiling the observations and information that were collected. Furthermore, secondary

data were identified and collected from both national and international brands, on internet pages, videos on YouTube and, mainly, Instagram (as it is a tool powered by an algorithm that feeds back the initial research, from the initial research topic, significantly helping secondary research). Secondary data mainly refers to the price analysis of shoes similar to that proposed by this research, enabling a comparative analysis of price reductions of at least 30%, thus corroborating the proposal of Weyrauch and Herstatt (2017). This secondary data analysis also aimed to observe customers' preference and approval for colored shoes. These analyses of secondary documents are presented in Figures 1 and 2, and also during the inferential analysis.

The third stage, called development, included the cost study of the economic and procedural feasibility of the frugal and sustainable tennis proposal. The economic feasibility study was carried out by expert 3 of this study. Furthermore, this third stage included the addition of fieldwork with three technical visits and one participation in an event (Yin, 2016) (Table 2). These activities aimed to deepen knowledge of the footwear production environment and how specialists work in this context. This perspective is described in studies on frugal innovation as the mindset of the frugal innovator (Soni & Krishnan, 2014; Weyrauch & Herstatt, 2017). Table 2 presents details of the four activities.

Table 2. Information about field research activities.

Description	Place	Date	Duration	Objective
<i>Grupo Sinos</i> C-Level Lecture with CEOs of footwear companies and other sectors	Feevale Theater, Novo Hamburgo	06/20/2023	5h	Listen to different perspectives on process management, creation, and innovation, as well as exchange experiences with professionals of footwear sectors and other sectors.
Technical visit guided by process and human resources managers	Footwear company in the Paranhana Valley, Rio Grande do Sul	06/24/2023	3h	Understand the footwear production and innovation process.
Guided tour of the museum with historical records and the process of administration and creation of a shoe company	Footwear company in Campo Bom, Rio Grande do Sul	06/29/2023	1h30	Know the company's historical record and observe the administrative, production, creative, and innovation processes.
Visit to the National Footwear Museum (<i>Museu Nacional do Calçado</i> — Feevale)	National Footwear Museum in Novo Hamburgo, Rio Grande do Sul	06/29/2023	2h	Get to know the historical record of the footwear industry in Rio Grande do Sul and learn about the processes of evolution, adaptation, and innovation of the footwear industry over the years.

Note. Source: Developed by the authors.

In the fourth stage of the research, which refers to the evaluation of the proposed sneaker and the development model based on frugal and sustainable innovation, the process of structured interviews with experts began (the entire research process always refers to the same seven experts, as detailed in Table 3) to present and evaluate the results. The interview guide consisted of structured questions based on the theoretical framework and the previous stages of information collection. In this stage of structured interviews, recording and transcription were carried out using the Microsoft Teams application in July 2023. The interviews

lasted approximately 45 to 60 minutes each, generating a total of 168 pages of transcription. No software was used to analyze the transcripts. Only one round of structured interviews with transcripts was conducted. The seven experts participated in the processes of: identifying the problem; suggestion; and development. Of the seven experts, only six participated in the two remaining processes: evaluation and conclusion (expert 7 had to leave the research due the change of work for a new company, making it impossible for him to continue in the study). Table 3 identifies the positions of the seven experts and their length of experience.

Table 3. Description of footwear experts.

Footwear Expert	Job Description	Years of Experience in the Shoe Business
Expert 1	Product development manager	42 years
Expert 2	Technical pattern maker — product development supervisor	22 years
Expert 3	Administration manager (human resources and costs)	30 years
Expert 4	Product development manager	18 years
Expert 5	Commercial manager	24 years
Expert 6	Full designer	18 years
Expert 7	Product development manager	16 years

Note. Source: Developed by the authors.

The experts were selected due to their experience in footwear development and production work. Care was taken to select experts from different shoe companies. The questions administered to the experts were as follows: '(1)

Are there other problems of wasted resources?'; '(2) Is there a need to change mentality toward innovation?'; '(3) Does the company work by listening to the needs of customers and society?'; '(4) What do you think of this project's idea

of creating a brand with cheap and innovative products to sell to a more price sensible class, with the aim of testing innovative models?'; '(5) How do you perceive the role of companies in relation to sustainability?'; '(6) What do you think about university and business interaction on a permanent basis over time?'; '(7) What do you think of the frugal and sustainable sneaker innovation developed by this project?'; '(8) What are the criticisms to be made of this project?'

Still on stage 4 of the research process (evaluation), the content analysis process was carried out. This stage of content analysis followed the prescription of [Bardin's method \(2006\)](#) which comprised the sequence of: (1) material collection (floating reading); (2) organization of the material; (3) focused reading; (4) objective definition; (5) definition of implicit guiding assumptions (in the case of this research, the implicit guiding assumption was to create an innovative product based on frugal and sustainable innovation); (6) coding and category; (7) data processing and statistics; and (8) presentation of inferential interpretation.

The data collected through fieldwork ([Yin, 2016](#)), participation in events, secondary data and structured interviews were analyzed under the following categories (as of Bardin's method step of coding and category): (1) bricolage; (2) change of mindset; (3) customer focus; (4) frugal innovation; (5) sustainability; (6) university and company interaction; (7) critical analysis.

The fifth and final stage, the conclusion, refers to the presentation of the results found in this research. The objective of this section was to present the reader with an overview of the strategic actions taken by some footwear companies with regard to frugal innovation and sustainability and also allowed the establishment of an inferential relationship on

consumer behavior. This preliminary study allowed us to propose a line of creation for a frugal and sustainable sneaker. Next, two proposals for artifacts for frugal and sustainable innovation are presented: (1) a frugal and sustainable shoe and (2) a method of research in collaboration between university and companies. The two artifacts are inseparable, since the method developed for this research gave rise to and validated a frugal and sustainable innovation product, and therefore they are presented together as a result of this study.

RESULTS

Using [Weyrauch and Herstatt \(2017\)](#) definition of frugal innovation as an analysis metric, it is possible to find on the market some footwear manufacturing company brands that seem to meet the requirements, especially the brand [Ötzi \(2023\)](#), from the city of Sapiranga, in Rio Grande do Sul. Compared to the average minimum price of reference brands in the market, such as [Adidas \(2023\)](#) and [Nike \(2023\)](#), which sell their products in an initial price range of R\$ 249.99, the brand [Ötzi \(2023\)](#), by selling for R\$ 99.90, meets the requirements: (1) substantial cost reduction of at least 30% in the product's offering price compared to other brands; (2) concentration on core functionalities; and (3) optimized level of performance ([Hossain, 2021a; Hossain et al., 2022; Reina et al., 2021; Schleinkofer et al., 2019](#)).

Other brands, such as [Olympikus \(2023\)](#) and [Mormaii \(2023\)](#), for example, also meet these requirements, but do not seem to present frugal innovation as a priority in their competitive strategy in the same way as the company [Ötzi \(2023\)](#) demonstrates, since that [Ötzi's](#) product, described as 16001 AB, for example, sold for R\$ 99.90, has been part of the company's product mix for more than three years as one of its main products.



Figure 1. Comparison of frugal products with leading brands on the market.

Source: Elaborated by the authors from sources indicated in the reference. (1) [Ötzi \(2023\)](#): R\$ 99,90; (2) [Coca-Cola \(2023\)](#): R\$ 129,90; (3) [Olympikus \(2023\)](#): R\$ 129,99; (4) [Kolosh \(2023\)](#): R\$ 149,90; (5) [Mormaii \(2023\)](#): R\$ 93,51; (6) [Umbro \(2023\)](#): R\$ 129,90; (7) [Adidas \(2023\)](#): R\$ 269,99; (8) [Nike \(2023\)](#): R\$ 229,99.

Through secondary data, we sought to identify the movement of brands, both Brazilian and international, that innovatively explore new style and color patterns in their models. An example to note is the case of the model from the brand Vans (2020), in partnership with the MoMA museum (Museum of Modern Art), in New York, in which the two feet of the same pair of sneakers do not respect a compatibility standard, neither of colors on both feet, nor

the shapes of the fabrics on the upper (upper textile part of the shoe).

Despite showing signs of innovation, none of these examples found presented characteristics that fulfilled all the frugal innovation items proposed by Weyrauch and Herstatt (2017), especially with regard to the affordable price aspect, since they are not products aimed at low-income consumers (Figure 2).



Figure 2. Analysis of innovative color products.

Source: Elaborated by the authors. (9) Vans (2020); (10) Samicce (2023); (11) Schutz (2023); (12) Audace (2023); (13) Shelter Women (2023); (14) MSCHF (2023); (15) Farm Rio (2023); (16) Stamp It (2023); (17) By Brava (2023).

One of the characteristics presented in the definition of frugal innovation is the interaction with customers, or rather, focus on the real needs of consumers, since frugal innovation seeks to overcome deficiencies in meeting needs, especially of consumers in regions of poverty, as already informed in the theoretical framework.

Based on this understanding, it was identified that some footwear brands use engagement through exclusivity as a strategy to compete. Such an approach requires concern and knowledge of customers' needs and desires and requires companies to be embedded in the environment, be it physical or cultural, of their consumers (Mulgan, 2006; Ploeg et al., 2022).

TWO ARTIFACT PROPOSALS FOR FRUGAL AND SUSTAINABLE INNOVATION

This study proposes two artifacts after the application of DSR (design science research), which are: (a) an 'instantiation', which refers to a colorful sneaker that uses

reused material (leftover materials) as its raw material; (b) and a 'method', which is the procedure applied in collaboration between the university and footwear experts (companies) for the development of sneakers. It was chosen to propose two artifacts because they are interconnected and inseparable, since in the creation of a pair of frugally innovative sneakers it was necessary to follow the method presented in this study. According to March and Smith (1995), when the artifact presents itself as an object or solution, it is considered an 'instantiation'; and it is considered a 'method' when it is a sequence of instructions on how to perform a task, study, or research. In the case of this study, the 'instantiation' deals with the proposal for a sneaker that uses frugal and sustainable innovation as a strategy; and the 'method' deals with the procedure on how to solve the problem of leftover materials in the shoe industries in partnership between university and industries in studies that, as a suggestion of this research, could take place every semester.

This research considered large footwear companies, with more than 10 thousand employees and daily production of more than 50 thousand pairs of shoes for other brands, in

a business to business (B2B) production system; or with the production of own brands; or even in a hybrid production situation, which encompasses both cases. Companies with these characteristics end up generating leftover materials that would be used in production, but which end up not being used, thus generating waste that can be used (bricolage) in other ways. In this regard, according to interviewees 1 and 2, “this is a problem that people normally don’t pay attention to.”

The proposal of the sneaker on this study is to use on its upper (which corresponds to the fabric on the entire upper part of the sneaker) the fabrics that were purchased for the production of the shoes, but that ended up not being used. Due to the unplanned variety of different types of fabric materials that remain, the proposal refers to the creation of an upper with random and different colors in all pairs of sneakers, thus generating a work of colors, resulting in originality and exclusivity for each client. The style and design of the sneaker model is standardized, only the pattern of shapes and colors of the print would be varied, creating a patchwork appearance on the upper. This type of creativity is already encouraged by the footwear industry, so much so that when researching colored footwear, interviewee 3 promptly requested permission to present some projects that also work with colors by saying: “... I’m going to show you a project, which is something I’m developing.” However, this project presented by interviewee 3 had no commercial intention, just like the proposal of this initial research, but it already showed the ability to think creatively and the perception that it is possible to work with different color patterns.

The first justification for this option of working with colors is due to research on websites and secondary sources, which demonstrated market acceptance of colorful and creative products (Figure 2). The second justification is the fact that this work, by joining and mixing fabrics and colors, helps reduce the cost of producing the product. After carrying out the cost analysis by one of the footwear cost specialists (expert 3), it was possible to reach a production value close to R\$ 70.00 (70 Brazilian reais). This calculation considered a large company registered in real profit (real profit means *Lucro Real* legal system of accounting in Brazil) and with already established production infrastructure. When considering the three criteria of frugal innovation — (1) substantial (Weyrauch & Herstatt, 2017) — it was possible to characterize this product as a frugal innovation.

Another characteristic presented in the theoretical framework that helps characterize this sneaker as a frugal innovation is the fact that it uses leftover materials available in the company itself, which eliminates the need for new acquisition, and which can be identified in frugal innovation as bricolage. Other materials that can be used are leftover

sewing thread. The fact that the product allows one to ‘play’ with colors increases the flexibility in using materials.

Parts of the product that need to be purchased and require additional investment are: the sole, the laces, and other components. These acquisition costs have already been included in the cost of R\$ 70.00. The calculated cost also included labor, which the company already has, as well as tax costs. With an approximate cost of R\$ 70.00 (total costs: variable and fixed) and applying a calculation error margin of 20% (R\$ 14.00), it was still possible to offer this product to the market at a final price of R\$ 95.00, thus meeting the other characteristic of frugal innovation, which is offering products at an affordable price to customers at the base of the social pyramid. This cost feasibility analysis was carried out with the help of specialist 3 (human resources and cost manager) and based on comparative information collected from the secondary data presented in Figure 1. Specialist 3’s interpretation of this analysis was: “... I think it’s brilliant. I find it very interesting. Because it covers everything we’ve talked about so far, right? Sustainability is the use of waste, the use of materials, taking care of nature ...”

When analyzing this innovation from the perspective of sustainability dimensions, it was possible to consider that: the item with the lowest impact (or zero impact) is the environmental one, as, on the one hand, it works with the awareness approach to the importance of avoiding waste, in this case waste of large proportions, when considering the production impact of a footwear company, but, on the other hand, it does not encourage the reduction of production or the encouragement of conscious consumerism (Mulgan, 2006; Pisoni et al., 2017; Radjou & Prabhu, 2015; Schumacher, 1973), since the company is just reusing a material that, in any case, would have been used to produce consumer products (footwear). However, this study observed the awareness of specialists in the footwear industry regarding the problem of waste and the opportunity (and need) to change this situation, as stated by specialist 5: “... there is a waste of materials, due to misuse ... due to wrong purchases ... wrong management ... it’s a matter of changing your mind, of thinking about sustainable solutions.”

The social requirement was met, since the brand proposes to offer a product at a price below the price charged by other brands. The final established price is R\$ 95.00. According to this study, this would be the brand with the most affordable price on the analyzed market as an intentional product strategy focused on an audience with lower purchasing power. The economic requirement was also met, as it helps companies rethink their internal processes to search for profitable and viable solutions for reusing leftover materials while stimulating creativity and innovation.

The theoretical framework presented by this article highlighted the understanding that the dialogue between

frugal innovation and sustainability needs to take place between different spheres in society, and cannot be restricted to just government actions (Albert, 2022; Mazzucato, 2022; Mulgan, 2006; Radjou & Prabhu, 2015; Reina et al., 2021; Stöber et al., 2022). The solutions sought and proposed by frugal innovation in convergence with sustainability do not happen in a punctual manner and isolated in time; there is a need for evolution and maturity to respond to new demands as dialogue (and actions) between those involved in the process takes place (Mazzucato, 2022; Mulgan, 2006; Radjou & Prabhu, 2015; Reina et al., 2021).

Concomitantly with the proposed artifact in the materialization of a sneaker with characteristics of frugality and sustainability, the perception of the need to continue this study between university and companies over time emerged (instead of just being a one-off study). This realization, in particular, is in the interest of everyone involved in this project, as it means an advantage for both. All experts were interested and willing to interact more with the university, as shown by expert 4: “I think this interaction needs to be more frequent.” The proposed artifact in this sense refers to the study method followed by this research (Table 4). The point of suggestion is that this research should take place every semester within a company or in relation to several companies, thus continuing the studies and the construction of solutions. The aim is to encourage dialogue between the

university and companies on an ongoing basis. Despite the intention to participate, interviewee 1 also criticized the stance of Brazilian universities, stating: “In Brazil, in general, for cultural and ideological reasons, universities are entities that are alien to the needs of economic actors ... it is as if they (universities) existed by themselves (apart from the needs of the economic actors).”

Therefore, the university responsible for the study gains in scientific production with knowledge in convergence with the practical problems of industries, while organizations gain from the possibility of counting on the university's help in promoting ideas and solutions to their problems. What was observed through this study is that companies do not have time to think and rethink their practices and processes. It becomes difficult for organizations to keep up with the constant change in theories and social demands for solutions, especially with regard to socio-environmental issues.

The reason for this article to propose two artifacts is justified by the fact that they are inseparable, since in order to generate the sneaker artifact it was necessary to go through the research method used here, a method that, once completed, generated observations and understandings that lead to think about the need and importance of continuing this type of study over time with the same university and the same companies.

Table 4. Practical research method for semi-annual application.

Frugal and Sustainable Innovation Research Proposal Artifact: Permanent/Sustainable Study (Semester) between Companies and University		
Phase	Description	Details
1	Identification of critical waste problem	1. Frugal innovation focuses on using materials (bricolage), hence the focus on finding solutions for waste in companies. 2. This stance allows for relationships with other business practices such as Six Sigma and Lean System, for example.
2	Selection of representatives of the frugal and sustainable innovation study	1. At this stage, the company selects company representatives who have experience in the affected area. 2. Throughout the research, other representatives from other areas of the company may be invited, as necessary. 3. Dialogue between different areas is fundamental and indispensable.
3	Contact the university to present the problem	1. Contact with the university refers to the first moment of presenting the problem to be resolved. 2. The university holds professors and students responsible for studying and producing the article.
4	Beginning of the study through practical resolution method	At this stage, researchers choose the research method to be used. Two possible suggestions are: 1. Design science research; 2. Design thinking. Other methods can be applied, as long as they meet the objective of seeking practical solutions for companies.
5	Results presentation	1. The result presented to the company is the suggestion for solving the problem. 2. The result for the university is the production of an academic article focusing on frugal innovation and sustainability.

Note. Source: Developed by the authors.

DISCUSSION OF RESULTS

The last stage proposed by the DSR (design science research) method refers to the conclusion of the research process with the presentation of the results to the experts involved in solving the problem, in accordance with the guidelines of [Vaishnavi and Kuechler \(2021\)](#).

The study identified that waste is a problem for companies, according to the perspective of all seven experts. Expert 3's response summarizes the perception of all other experts: "Yes, the product, the shoe, generates a lot of waste." In the understanding of experts 1 and 2, this is a problem with more complex implications in the product development and production process: "It's something that people normally don't pay attention to ... because it's not taken into account in the project, when I'm designing the project." This reading of the waste that begins with the design of the project was also warned by expert 6: "... a waste of the model ... would suddenly have to be just in the drawing." In this way, the bricolage technique proves to be a useful tool for companies, and together with experts, it revealed the need to reduce the occurrence of decisions and processes that generate leftover materials.

In this way, the intensity with which bricolage is adopted in an organization is directly linked to subjective knowledge about the use of resources, being fundamental to boost innovation in products, businesses, and company strategies ([Nodari et al., 2022](#); [Sarkar & Mateus, 2022](#)). For [Gaur et al. \(2014\)](#) and [Beise-Zee et al. \(2021\)](#), a high level of interpersonal skills is the key to the success of bricolage in companies, as it allows for a 'collaborative mentality' and network. In turn, bricolage enables a process of mutual co-evolution between company and bricoleur ([Cunha, 2005](#)), contributing to a change in the price-performance paradigm ([Busch et al., 2018](#)) with great potential for eco-innovations ([Pansera & Sarkar, 2016](#); [Sarkar & Pansera, 2017](#)), sustainable innovations, and environmental sustainability ([Iqbal et al., 2020](#); [Rizzo et al., 2020](#)).

Additionally, studies of frugal innovation predict the need for a change of mindset for this type of innovation, since, for example, frugal innovators understand that innovation does not need to be created with high investments and can arise from ingenuity and concern about supplying underserved sectors of society ([Radjou & Prabhu, 2015](#); [Soni & Krishnan, 2014](#); [Weyrauch & Herstatt, 2017](#)).

In general, everyone (all the experts in this study) agrees with the importance, complexity, and need to innovate, to think and act differently in companies. Each expert, however, contributed with a particular perception of the moment each company is going through. For expert 6, factories still have a mentality focused on the past and need to evolve in terms of innovation. On the other hand, specialist 5 does

not see a problem with the need to change mentality toward innovation, as he understands that the footwear industry is fast and dynamic, which forces companies to be innovative if they want to remain competitive in the market. Expert 5 added: "... the fact that shoe factories have relationships with international clients from big brands, which are very innovative, demands changes in processes and products from factories." Furthermore, according to him (expert 5): "factories that do not adapt to this reality are automatically excluded from this highly competitive market."

Expert 4 said: "... I have never come across a company that had such a mentality focused on innovation, with structured sectors designed only for innovation." This same reality was observed during the technical visit to the footwear company in Campo Bom, RS, which also dedicates exclusive sectors to innovation. Both companies use a similar tool to stimulate innovation, which is an area of the company with archives of shoe parts and materials that can be consulted to stimulate innovation. In other words, there is a space for creativity that transmits to employees the message that the company encourages innovation, according to observations carried out in the company.

Expert 1 brought the perspective that "... innovation does not require a change of mentality only on the part of leadership." According to him, people often complain about the lack of openness on the part of leadership to listen to innovative proposals, but the problem lies in the way the ideas are presented. In the words of expert 1: "The innovation proposal needs to be well presented by whoever has the idea ... I have an innovation proposal, I need to design it." According to him, it is necessary to make gains visible to the business or how the company can stop losing money.

The literature shows that frugal innovation occurs from the perception of customer needs that are not met, especially those in situations of poverty and precariousness ([De Marchi et al., 2022](#); [Radjou & Prabhu, 2015](#); [Sheikh et al., 2023](#); [Weyrauch & Herstatt, 2017](#)). From the interviews with the experts, it was possible to observe that none of them work for companies that have a product portfolio strategy focused on meeting the needs of the base of the pyramid. Even so, experts 3 and 6 revealed strategies aimed at customers, such as, for example, sneakers developed with a focus on the comfort and development of children's feet, in the case of a children's brand, and work aimed at people with disabilities, and who need shoes with specific characteristics.

For expert 1, "... the company wants to know how it can make money with some innovation. The business leadership will not invest in something that cannot show this possibility." This observation reveals a complex impasse to resolve, since, on the one hand, there is the aim of producing products that provide profits for companies, to

the detriment of what people actually need and, on the other hand, there is a class socially unassisted and which economically may not represent commercial interest for companies.

However, the logical impasse does not lie in these two contradictory points only, but also in a third complicating factor that is introduced when thinking about the challenges of sustainability, which does not necessarily represent a perspective of only profit for companies, but which definitely appears as social and environmental issues to be faced by companies. Therefore, the question arises: what is the true purpose of companies' existence? Is it to only look for and generate profits, or also meet socio-environmental needs?

Frugal innovation designed for sustainability seems to offer a path for dialogue that initiates a debate that takes into account the demands of both companies and society regarding these issues, and this seems to be evidence of the importance of studies on frugal innovation. Respondents were asked how they perceive the potential of frugal innovation. Despite expert 1's criticism and rationality regarding the companies' central objective of making a profit, he also revealed the fact that he had already worked for a company that developed, thirty years ago, a sneaker with characteristics very similar to those presented in this study. According to him, "it wasn't a best seller, but it was well received."

Experts seem to understand that this is not simply a study aimed at reducing costs, which is a point of high interest for companies, but that it goes further, proposing to rethink innovation and the potential of frugal innovation for companies and the society. All experts evaluated the project (artifact) as viable, not only in the sense of the product that was designed, but in relation to the mentality that this type of project awakens in entrepreneurs. Likewise, all experts demonstrated interest and engagement in contributing to the construction of this study, which was revealed not only in words, but also in action, as openness on the part of the footwear industry to innovate and willingness to understand and apply frugal innovation.

All experts consider sustainability to be a fundamental topic for footwear companies. At first, this is a perception on the part of experts that arises from the pressure suffered by companies, from the government and from customers, with regard to sustainability issues. In this sense, expert 1 points out: "It is a necessity, medium and large companies have no other option, today this has become fundamental." Expert 4 reported situations in which customers, in this case other companies, in a B2B relationship, in the middle of a visit to the company, interrupted the dialogue to make sure that the company complies with legal sustainability requirements (otherwise it would not be possible to continue commercial activities). Only expert 5 identified that some

companies pursue sustainability actions because they believe in the intrinsic ideal of environmental movements. Expert 6 considers that movements in search of sustainability are still incipient.

Throughout this research, which focused on the development of the colorful sneaker artifact, it was realized the relevance and importance of this study, especially with regard to the close relationship between the university and companies. Therefore, the need to continue this type of research over time was identified, as opposed to just a one-off or one-semester study. This finding is also highlighted by the frugal innovation literature (Reina et al., 2021).

Experts 1 and 5 demonstrated their dissatisfaction with the fact that they perceived a gap between the work that companies carry out and the studies that universities carry out. This reinforces the understanding that there seems to be a need for closer work between the university and companies. Experts 3, 4, and 6 demonstrated motivation and interest in a project in this regard. It is worth highlighting the answer from expert 3: "In my opinion, interaction between universities and companies could benefit both parties ..."; and further: "... companies often face complex challenges and problems that can benefit from the experience and knowledge of universities."

In the case of this research, this proposal is even more significant due to the fact that the university itself has the National Footwear Museum (in Portuguese, MNC, *Museu Nacional do Calçado*), with a collection of more than 45 thousand pieces, which aims to preserve and value the history of industrial footwear production of the region (*Museu Nacional do Calçado*, 2023). This fact demonstrates the university's concern and appreciation for the work of the footwear industry, at the same time as it reveals the companies' interest in collaborating, as the museum counts on companies and businesspeople donating several items to the collection.

All experts reiterated their understanding that the two proposed artifacts have applicability, both in terms of creating a frugal and sustainable sneaker and in the relationship between companies and university. The experts took the opportunity to propose other ideas that could be explored throughout other studies. This attitude of participation and motivation on the part of experts demonstrates, once again, the interest on the part of companies in participating in innovation actions and in interacting with different social actors (in this case, the university) in the search for profitable and educational solutions. The words of expert 4 summarize the observation of the other experts when he said: "I think it's a great idea. I think it took a while for us to come up with an idea like that."

For expert 6, who is a footwear designer, the idea of a very colorful sneaker for a frugal concept may not be a good strategy. According to him, a potential audience for frugal products is not willing to buy “such innovative” products. For the expert, ideas that focus on exploratory creativity have a greater chance of success with audiences in a higher economic condition. This perception from expert 6 is confirmed when analyzing the secondary study presented in the analysis of the brands presented in this article with shoes on Instagram. The most colorful and sustainable product brands were also the most expensive.

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Therefore, despite expert 6’s reservations in terms of the color, the fundamental issue today is how to generate and distribute knowledge, flexible regulations, technological diversity, as well as increasing the capacity to learn about the impacts of these innovations, supporting the transition to the dimensions of sustainability (Brem & Ivens, 2013; Silva et al., 2022). In this context, the responsibility for ensuring sustainability falls largely on companies, as they are considered the largest generators of environmental impacts at different levels, depending on their productive activities and the intensity of use of energy and natural resources, as well as consumption of goods and services they produce and sell, growing in mass. These companies play a fundamental role in the development, dissemination, and adoption of sustainable technologies that move toward the new standard (Agarwal et al., 2021; Brem & Wolfram, 2014).

FINAL CONSIDERATIONS

The article aimed to analyze how frugal innovation could be applied in line with sustainability principles in footwear companies. It was possible to identify two artifacts: a frugal and sustainable sneaker ‘instantiation’; and a study ‘method’ in partnership between university and companies over time (instead of one-time studies).

It was found that the problem of leftover materials in production is caused by a lack of communication between

sectors inside the company and the production chain, as those responsible for the sectors do not stop to think about solutions (frugal innovations) that can even promote sustainability. On the other hand, the research identified the interest and engagement of representatives (experts) of footwear companies in trying to find innovative solutions, which demonstrates that there is interest and openness to new studies.

The proposal for frugal and sustainable sneaker (instantiation) and the proposal to continue a long-lasting research project between university and companies (method) were planned and validated with experts, but did not have viable time for practical analysis, therefore, their applicability still needs to be tested and implemented. Indeed, the results show that frugal innovations have a potential for sustainable transformation that must be observed. The processes of development and diffusion of innovations can serve as a link between companies, universities, and technology research and innovation centers; and, in a dialogical way, is able to articulate technical-scientific knowledge and researchers with the tacit knowledge of organizations and of other epistemes, from where, for example, bricolage emerges as a product of Brazilian innovative capacity and creativity. Furthermore, the research proposal of this study helped identify how companies can improve their internal processes and develop new frugal solutions to reduce the potential risks inherent to production. Therefore, one practical contribution of this research is the dissemination of this frugal innovation knowledge to the academic community, to policymakers and, mainly, to the footwear sector, providing the diffusion of these innovation ideas and, therefore, promoting the sustainable development of producing regions from this research results.

One of the limitations of the study is the fact that it lasted less than a semester, and one of the findings of the research was that both university and companies would benefit from a lasting work project over time.

The suggestion for future research is to apply the proposals built in this research and evaluate the results in the footwear sector, which can be extended to other industries and universities. A survey of potential consumers of this type of product is suggested to verify that the needs and necessary adjustments are met.

Furthermore, research could be developed on value co-creation and frugal innovation to identify how different social actors could contribute and collaboratively build a product made from leftover materials in accordance with the needs and principles of sustainability.

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The authors informed that there is no conflict of interests.

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The authors claim that all data used in the research have been made publicly available, and can be accessed via the Harvard Dataverse platform:



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