Mix Sustentável

Design para a sustentabilidade e circularidade: valorização de resíduos têxteis na produção de empreendedores da economia criativa

Design for Sustainability and Circularity: Textile Waste Valorization in the Production of Creative Economy Entrepreneurs

Diseño sostenible y circular: valorización de desechos textiles en emprendimientos de la economía creativa.

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Resumo: Este artigo apresenta os resultados de uma pesquisa de mestrado desenvolvida na Universidade do Estado do Rio de Janeiro, sobre o desenvolvimento de produtos com resíduos têxteis por pequenas e microempresas da economia criativa e circular brasileira. O objetivo foi descrever os processos produtivos e os desafios envolvidos no reaproveitamento desses materiais. A amostra incluiu onze empresários responsáveis pela criação e design dos produtos. A pesquisa, de caráter qualitativo, utilizou formulários, entrevistas semiestruturadas e análise documental para a coleta de dados. Os resultados da análise documental, cotejados com as respostas das entrevistas e do formulário converteram-se em nove catego-

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rias, organizadas em três eixos principais: ‘economia circular e criativa’, ‘ciclo de vida dos produtos e reaproveitamento de materiais’ e ‘design de produtos’. A partir da análise, pode-se afirmar que os assuntos agregam os fatores basilares para o desenvolvimento de produtos sustentáveis que tem resíduos têxteis como a matéria-prima principal. Esses eixos se inter-relacionam e fundamentam práticas sustentáveis. Como conclusão, o estudo indica que essas empresas tendem a atuar próximas às fontes de resíduos — seja junto a indústrias (pré-consumo) ou aos locais de descarte (pós-consumo) — e que o design exerce papel central na construção de processos produtivos mais responsáveis do ponto de vista ambiental. Além disso, o design contribui significativamente para a criação de produtos funcionais e esteticamente atrativos dentro da lógica da economia circular, ao promover o reaproveitamento de matérias-primas. Esse apelo estético e funcional, aliado à narrativa sustentável, agrega valor comercial aos produtos, ampliando seu potencial de aceitação no mercado. Como resultado, o design não apenas favorece práticas ambientalmente conscientes, mas também impulsiona as vendas, fortalece a competitividade e contribui diretamente para a continuidade e o crescimento dos negócios.

Palavras-chave: design para a sustentabilidade; design de produto; resíduos têxteis; economia circular; economia criativa.

Abstract: This paper presents the findings of a Master’s research project conducted at the State University of Rio de Janeiro (UERJ) regarding product development using textile waste by Brazilian micro and small enterprises (MSEs) within the creative and circular economy. The study aimed to describe the production processes and challenges involved in repurposing these materials. The sample comprised eleven entrepreneurs responsible for product creation and design. This qualitative study employed data collection through forms, semi-structured interviews, and document analysis. The results of the document analysis, triangulated with the interview and form responses, yielded nine categories organized into three primary axes: ‘circular and creative economy,’ ‘product life cycle and material repurposing,’ and ‘product design.’ The analysis indicates that these themes encompass the foundational factors for developing sustainable products that utilize textile waste as their primary raw material. These interconnected axes provide a framework for sustainable practices. In conclusion, the study suggests that these companies tend to operate in close proximity to waste sources—whether industrial (pre-consumption) or disposal sites (post-consumption)—and that design plays a pivotal role in constructing environmentally responsible production pro-

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cesses. Furthermore, design contributes significantly to creating functional and aesthetically appealing products within the circular economy logic by promoting material reuse. This aesthetic and functional appeal, coupled with a sustainability narrative, adds commercial value to the products, enhancing their market potential. Consequently, design not only fosters environmentally conscious practices but also drives sales, strengthens competitiveness, and directly contributes to business continuity and growth.

Keywords: design for sustainability; product design; textile waste; circular economy; creative economy.

Resumen: Este artículo presenta los hallazgos de una investigación de maestría desarrollada en la Universidad del Estado de Río de Janeiro (UERJ) sobre el desarrollo de productos a partir de residuos textiles por micro y pequeñas empresas de la economía creativa y circular brasileña. El objetivo fue describir los procesos productivos y los desafíos vinculados a la revalorización de estos materiales. La muestra estuvo conformada por once empresarios responsables de la creación y el diseño de los productos. La investigación, de carácter cualitativo, empleó formularios, entrevistas semiestructuradas y análisis documental para la recolección de datos. Los resultados del análisis documental, contrastados con las respuestas de las entrevistas y los formularios, se tradujeron en nueve categorías organizadas en tres ejes principales: 'economía circular y creativa', 'ciclo de vida de los productos y reutilización de materiales' e 'diseño de productos'. A partir del análisis, se puede afirmar que estos temas reúnen los factores fundamentales para el desarrollo de productos sostenibles que utilizan residuos textiles como materia prima principal. Estos ejes se interrelacionan y fundamentan las prácticas sostenibles. Como conclusión, el estudio indica que estas empresas tienden a operar cerca de las fuentes de residuos —ya sea junto a las industrias (preconsumo) o en los puntos de descarte (posconsumo) — y que el diseño ejerce un papel central en la construcción de procesos productivos más responsables desde el punto de vista ambiental. Además, el diseño contribuye significativamente a la creación de productos funcionales y estéticamente atractivos dentro de la lógica de la economía circular, al promover la reutilización de materias primas. Este atractivo estético y funcional, aliado a la narrativa sostenible, añade valor comercial a los productos y amplía su potencial de aceptación en el mercado. En consecuencia, el diseño no solo favorece las prácticas ambientalmente conscientes, sino que también impulsa las ventas, fortalece la competitividad y contribuye directamente a la continuidad y al crecimiento de los negocios.

Palabras clave: diseño para la sostenibilidad; diseño de productos; residuos textiles; economía circular; economía creativa.

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1 INTRODUCTION

Every year in Brazil, large quantities of textile waste are discarded. The Sustexmoda research group, based at the University of São Paulo, periodically surveys the volume of textile waste collected in the city of São Paulo by LOGA (Logística Ambiental de São Paulo S.A.), the concessionaire responsible for municipal solid waste collection.

Accounting for textile waste began in 2017, and by March 2025 a total of 90,785 thousand tons of textile waste had been collected, including 63,255 tons of industrial material and 27,530 thousand tons of post-consumer material (Sustexmoda, 2025). It is also relevant that, over the past decade, a growing number of consumers have shown changes in behavior regarding consumption. According to the report "An Eco-Awakening" (Economist Intelligence Unit, 2021), the search for sustainable products increased globally by 71% since 2016. Driven by these requirements, emerging enterprises are transcending the traditional focus on profit and growth, integrating sustainability and net-positive social and environmental outcomes into their core missions.

Despite this promising scenario, Brazil's National Solid Waste Policy (PNRS), established by Law No. 12,305/2010 (Brasil, 2010), presents significant gaps regarding the treatment of textile waste. The legislation does not specify clear guidelines for the disposal or reuse of these materials, either in industrial contexts or post-consumer, which hinders the creation of public policies and private initiatives aimed at efficient management. The lack of regulatory frameworks prevents textiles and fibers from being integrated into conventional waste streams, thereby hindering their reincorporation into closed-loop productive cycles.

It is also important to distinguish recycling from reuse. While textile recycling often results in products of lower added value (downcycling), reuse—especially through upcycling—allows waste to retain or increase its value by being transformed into new products with aesthetic and functional appeal (Mcdonough; Braungart, 2002). This practice adds economic and symbolic value, aligning with the principles of the creative and circular economy.

In this context, product design plays a strategic role. Designers' work—considering functionality, aesthetics, ergonomics, sustainability, and economic feasibility—is fundamental to maximizing the use of textile waste. Design for sustainability proposes a critical and systemic approach (Manzini, 2008) , in which design decisions are guided by ecological and social values, contributing to innovative and responsible solutions (Fletcher; Grose, 2011).

Given this context, it is worth noting that detailed data on textile waste management, as well as the use of textile waste as raw material by companies, are not widely available. Accordingly, the research presented here investigates product development in small and microenterprises within Brazil's creative and circular economy that use textile waste as raw material, where design—through aesthetics and functionality—serves as an attraction for sales.

The research topic—using solid textile waste as raw material in product design within creative and circular economy companies—is justified by the need to organize knowledge on this subject, and also by the

lack of available data on these companies, their methods, and their creative and production processes using textile waste within Brazil's productive sector.

Within this framework, theoretical discussion of the role of design in promoting sustainability contributes to grounding the analysis of practices observed in the investigated companies. Authors such as Manzini (2008) and Thackara (2008) reinforce the importance of rethinking the role of design in contemporary society. For Manzini, sustainability should be the meta-objective of all design practice, while Thackara highlights the impact of small design decisions on the system as a whole. These authors argue that design can be a powerful tool for the transition toward more sustainable models of production and consumption.

The research universe consisted of small Brazilian companies and individual micro-entrepreneurs that use textile waste as raw material in the production of new products. The population comprises entrepreneurs responsible for creating the products. The interviewed sample included eleven specialists in their areas of activity, selected based on the availability of online information about the companies' sustainable practices. Another selection criterion was that the company developed product design by using textile waste in its original state, through reuse, without undergoing recycling.

The research question investigated is: how can design for sustainability help improve product design projects and map design characteristics in creative and circular economy companies that use textile waste as raw material?

To answer this question, the following general objective was defined: to describe product development processes in companies that use textile waste as the primary raw material, discussing challenges inherent to the reuse of this material.

The specific objectives are organized into five actions:

(a) to outline the theoretical framework based on sustainability, sustainable development, circular economy, and creative economy concepts, indicating the intersections of these areas with design;

(b) to outline an overview of textile waste use in Brazil, demonstrating the importance of creating conditions to increase the reuse of this raw material;

(c) to describe industrial textile production processes, conceptualizing textile waste;

(d) to investigate the use of design principles in the reuse of textile waste in small companies based on the data collected in the sample;

(e) to highlight the relevance of design for sustainability as a means to improve the use of textile waste, strengthening the creative and circular economy, as well as optimizing the use of this raw material.

Given the growing generation of textile waste in Brazil and the demand for sustainable practices in the productive sector, this research investigates how small and microenterprises within Brazil's creative and circular economy have used textile waste as raw material in product development. Using a qualitative approach, with theoretical review, document analysis, and interviews, the study seeks to understand the challenges and potential of reusing these materials, especially through design for sustainability. By integrating concepts such as circular economy, upcycling, and sustainability, the study aims to contribute to strengthening practices that promote the conservation of natural resources, the valorization of creative labor, and the adoption of sustainable practices in Brazil's textile production system.

2 THEORETICAL FRAMEWORK

This section starts from the broad topic of sustainability to address related themes relevant to this research. It is divided into two parts. The first, "Sustainability, Creative Economy, and Circular Economy," presents definitions of the main concepts. The second, "Textile Waste and Product Life Cycle," discusses the waste problem in textile production and introduces the Life Cycle Design method (Manzini; Vezzoli, 2016), adapted to the life cycle of textile products.

2.1 Sustainability, Creative Economy, and Circular Economy

This first part addresses broad concepts—sustainability, the creative economy, and the circular economy—that underpin the analysis developed in this study.

Sustainability gained international prominence from the 1970s onward, with global conferences that culminated in the formulation of the concept of Sustainable Development—understood as seeking to meet present needs without compromising future ones (PNUMA, 2021). Although these initiatives have fostered practices aimed at environmental preservation, they often favor large corporations and developed countries, failing to fully incorporate local realities and smaller companies (Planelles, 2017).

In this context, it is essential to adopt a critical view of how these concepts are used, since they can serve both to promote positive change and to perpetuate economic models based on the exploitation of resources and labor. Clean production and the green economy, for example, can be legitimate strategies for transformation, but they can also be used to conceal conventional market practices (Fletcher; Grose, 2011).

For the field of design, particularly product design, this debate is relevant. Design for sustainability proposes solutions that valorize material reuse—such as textile waste—and contribute to products with lower environmental impact. By incorporating ethical, aesthetic, and functional principles, design becomes a strategic tool in the transition to more circular and responsible production models, especially in small enterprises operating in the creative economy.

The concept of sustainability spans multiple definitions depending on the field of application. For Manzini (2008), the term is divided into an environmental dimension, focused on ecosystem resilience in the face of human activities, and a social dimension, grounded in intergenerational commitment to the future of collectives. This research expands that view by integrating the economic dimension from Sachs (2008) perspective, which defines sustainability as efficient and distributive allocation of resources. In this scenario, the circular and creative economies are adopted as means to enable this triad: entrepreneurs use financial efficiency not as an end in itself, but as support for restoring ecosystem health and strengthening community well-being.

The idea of a creative economy stands out as an alternative to the industrial economy. Creative economy activities are related to intellectual capacity, individual skills, and talents. Teixeira e Corrêa (2015) note that the

creative economy is a broad concept that encompasses economic activities associated not only with creativity, but also with innovation, education, scientific research, and product and service development research. Because functions involving intellectual capabilities are considered part of creative activities, it has become complex to list which professions belong to the creative industry. Filho (2015) explains that "the creative industry involves a range of disciplines that articulate and interact with one another, generating a network structure." From this perspective, design, as a multidisciplinary activity, is understood as part of the creative industry.

The concept of a circular economy, in contrast to the linear economy model, is within the scope of this research because the selected sample of companies uses textile waste as raw material. The linear economy—still predominant in industry—is based on resource extraction, production, consumption, and disposal. The circular economy, in turn, proposes a closed cycle in which products are conceived from the outset to return to the production process as raw material at the end of their useful life. Materials such as metals can be recycled indefinitely, while paper and plastics have limited cycles due to quality loss. Even so, the circular economy model reduces resource extraction and waste generation, making it more efficient than the linear system.

The circular economy's main characteristic is the full use of materials in a closed loop. For Eijk e Joustra (2017), it is "an economic model in which the value of raw materials is maintained or recreated through the durability and/or reuse of products, and growth is decoupled from exploitative use of natural resources."

Adopting the circular economy requires understanding product life cycles and the environmental and social impacts of consumption (Santos *et al.*, 2019). According to the authors, education for sustainability is essential in this process, as it enables consumers to make conscious choices that benefit both the environment and society.

From the definitions of the creative economy and the circular economy, it becomes clear that one complements the other. The circular economy, grounded in natural cycles, can be strengthened through creativity directed toward the sustainability of systems, populations, and cultures.

Against this backdrop, design—as an area integrated into productive systems—has economic relevance in society, since design projects may lead either to polluting artifacts or to products aligned with the pillars of sustainability. According to Russo e Berlim (2020), the socio-environmental crisis stems from the interfaces and design intentions created by humans. From this perspective, design becomes a strategic mediator between production and sustainability, with the responsibility to enable more conscious development models.

Design is a field of knowledge and production rooted in creativity. Designers create artifacts that initially were not tangible and were conceived in their thoughts through connections among different bodies of knowledge. This ability to adjust contexts makes designers capable of acting in the complex environment of contemporaneity. In this sense, Filho (2015) observes that "in constructing this new paradigm under development, design emerges as a linking element between previous structures and the perspectives intended for the future," reinforcing the role of design as a mediator between tradition, innovation, and social transformation.

Thus, the concepts of sustainability, the creative economy, and the circular economy interrelate with design as a basis for the analysis proposed in this research.

2.2 Textile Waste and the Product Life Cycle

This second part addresses specific concepts—textile waste and the product life cycle—that deepen the analysis developed in this research.

Waste is part of a product's life cycle and may become 'reject' if it consists of toxic or infectious materials, or if it is not separated at the source, preventing reuse and recycling. According to Brazil's National Solid Waste Policy (Brasil, 2010), rejects are solid waste that, after exhausting treatment and recovery possibilities using available and economically viable technological processes, has no alternative other than environmentally appropriate final disposal. Under this legislation, textile waste is classified as solid waste; however, there is no specific guideline for this material, leaving industries, garment makers, retailers, and consumers to decide how to dispose of it, which exacerbates environmental problems.

Textile waste consists of materials that remain from the manufacture of textile products and also the products themselves after disposal. Classified as pre-consumer waste, it includes surplus materials from manufacturing, weaving, dyeing, printing, and garment making. This category includes defective fabric rolls, garment scraps, and finished products discarded by companies due to defects or overproduction. Post-consumer waste consists of products used by consumers and discarded because they are worn out or out of fashion (Chavan, 2014).

Currently, one alternative discussed for achieving a circular economy for textiles is EPR—extended producer responsibility. This is a policy tool to ensure that discarded textiles are collected and put back into circulation at scale. To date, three countries have adopted EPR policies for textiles: France, Hungary, and the Netherlands (Ellen MacArthur Foundation, 2024).

Legislative updates in Brazil, such as Decree No. 10.936/2022, introduced the National Reverse Logistics Program, aiming to improve solid waste management. Bill No. 270 of 2022 (Brasil, 2022), currently under consideration in the Chamber of Deputies, proposes a national reverse logistics system for textile waste, including the collection and recycling of used products and industry leftovers. However, the current absence of specific regulation exacerbates the environmental challenges associated with this material. "The lack of a textile waste management policy makes it difficult to map the true socio-environmental impacts of the textile industry" (Modefica; FGVCES; Regenerate, 2020). Thus, the regulatory gap compromises not only waste management but also the understanding of its impacts.

In 2025, the São Paulo city government implemented a collection point exclusively for textile waste in a region with many garment manufacturers that suffers from improper disposal. Currently, however, the materials are directed for use as fuel, i.e., they are incinerated. "Textile waste will be used as RDF—Refuse-Derived Fuel—which can be used to power industrial cement, lime, or biomass kilns, replacing fossil and mineral fuels" (Prefeitura de São Paulo, 2025). Directing textile waste to the production of refuse-derived fuel (RDF) is a suboptimal eco-efficiency strategy, although it substitutes fossil fuels in industrial kilns. The Waste Hierarchy, a principle established by the National Solid Waste Policy (Brasil, 2010), prioritizes reuse and recycling before energy recovery such as RDF. From this standpoint, making use of textile waste through sorting and directing

it for reuse in its original state or recycling is more aligned with circular economy principles. Such practices maximize material value and conserve natural resources, minimizing energy consumption and carbon emissions associated with producing new fibers.

The complexity of the textile production chain makes it difficult to trace socio-environmental impacts, since the chain is highly fragmented and involves multiple suppliers. In Brazil, textile waste reuse remains limited despite its economic and environmental potential. Reuse depends on factors such as cleanliness and proper separation of materials, as well as collection infrastructure and business models capable of absorbing this raw material (Marchi, 2020). Recycling can be mechanical through fiber opening/shredding, or chemical, in the case of synthetic fibers such as polyester, which undergo melting and extrusion processes (Amaral, 2016).

Reuse maintains the original characteristics of the material and does not require complex industrial processes. However, it is more challenging because it requires specialized labor and longer production time, which increases the final product's cost (Amaral, 2016). Even so, this practice is viable for small entrepreneurs and artisans, who use accessible techniques such as cutting and sewing to transform waste into new products. For this reuse to succeed, the involvement of design is essential, contributing creative and functional solutions for efficient material use.

Sustainable design, in this context, becomes a strategic tool for transitioning the textile industry toward a circular economy. By considering aesthetic, functional, and environmental aspects, design can add value to waste, transforming it into desirable and durable products. In addition, it promotes awareness of responsible consumption and strengthens more ethical and inclusive production models, especially in small creative-economy enterprises.

Thus, the effectiveness of sustainable design is linked to its ability to positively influence all stages of the product life cycle.

A product life cycle refers to the phases from production to disposal. Manzini e Vezzoli (2016) consider that "the product is interpreted in relation to the flows of matter, energy, and emissions of the activities that accompany it throughout its life." They clarify that the life cycle encompasses the extraction of resources needed to produce the materials that make up the product (birth) through to the final treatment (death) of these materials after use.

In the Life Cycle Design methodology, Manzini e Vezzoli (2016) define five product life cycle phases to identify a product's main problem and prioritize actions for design for sustainability: (1) pre-production; (2) production; (3) distribution; (4) use; and (5) disposal.

Adapting this methodology to the textile product life cycle yields the following organization:

Table 1 – Adaptation of Life Cycle Design for Textile Products

Phases of the Product Life Cycle	Stages of the Textile Product Life Cycle
1. Pre-Production	Fiber production, spinning, weaving, and dyeing.
2. Production	Design and manufacturing.
3. Distribution	Packaging, distribution, and product sales.
4. Use	Product use and maintenance by consumers.
5. Disposal	Linear Destination: Landfills or incineration. Circular Destination: Re-purposing (Reuse) or recycling.

Source: Ziegler (2022).

The companies in the interviewed sample develop product design using textile waste and share the common characteristic of inserting themselves into the life cycle of other products. When they use pre-consumer textile waste, such as garment-making scraps, they insert themselves into the production stage of the life cycle of the product used as raw material. When they use post-consumer textile waste, they insert themselves into the disposal stage of the life cycle of another product.

The terms defined in this theoretical framework—sustainability, creative economy, circular economy, textile waste, and product life cycle—pave the way for creating innovative solutions for textile waste valorization. This means using design to create new products from fabric leftovers in a conscious and efficient manner. This approach not only reduces waste and environmental impact but also generates economic and social value, encouraging creativity and environmental responsibility.

3 METHODOLOGICAL PROCEDURES

This research used a narrative review as its methodological basis, following Rother (2007), with the objective of discussing the themes of the textile industry, the creative industry, and environmental sustainability through the analysis of up-to-date books, articles, and informative reports. Knowledge obtained at this stage supported the development of a qualitative study focused on investigating design-for-sustainability contributions to projects developed by small and microenterprises in Brazil's creative and circular economy that use textile waste as raw material in product design.

The research objective was to describe product development processes in companies that use textile waste as the main raw material, discussing challenges inherent to reusing this material.

The universe of interest consists of small Brazilian companies and individual micro-entrepreneurs that use pre- and post-consumer textile waste as raw material in product production. The population comprises these entrepreneurs, who are responsible for product design.

Sample selection was conducted using Google and Instagram. On Google, the following keywords were used: "textile waste," "sustainable product," "textile reuse," "textile upcycling," and "design with textile waste." On Instagram, the following hashtags were used: #textilewaste, #zerowastefashion, #textileupcycling,

#circularfashion, and #sustainablefashion.

Based on the search results, companies were required to meet the following selection criteria: they had to be formalized businesses; operate in apparel and accessories; be based in Brazil; adopt a creative and/or circular economy approach; and, finally, use textile waste in its original state—without recycling—through reuse in product production, applying methodologies in their development.

The sample comprised eleven entrepreneurs considered specialists in their areas. Selection was motivated by compliance with the stipulated criteria, accessibility of information about their sustainable practices, and willingness to participate in interviews.

The sample profile includes eight women and three men responsible for micro and small enterprises, aged 25 to 45, with education in business administration, architecture, biology, law, design, environmental management, fashion, social work, and tourism. The companies are located in Brazil's South, Southeast, and Northeast regions and reuse various types of pre- and post-consumer textiles.

The sample develops product design using textile waste and shares the common characteristic of inserting itself into the life cycle of other products. By using pre-consumer textile waste, such as garment scraps, they insert themselves into the production stage of the life cycle of the product used as raw material. By using post-consumer textile waste, such as used clothing, they insert themselves into the disposal stage of the previous product's life cycle.

The number of eleven interviewees was defined through theoretical saturation, identified through analysis of participants' responses. When information provided by participants began to repeat, saturation was considered achieved.

Sample closure by theoretical saturation is operationally defined as suspending the inclusion of new participants when the obtained data begin to show, in the researcher's assessment, a certain redundancy or repetition, and it is not considered relevant to persist in data collection (Fontanella; Ricas; Turato, 2008).

Therefore, the sample was considered sufficient in light of this methodological criterion and is presented in Table 2, which lists the companies, their location, the type of textile waste used, the artifact produced, the year operations began, and the type of legal entity registration.

Table 2 – Sample Information

Company	Location	Waste Used	Product	Start of Activities	Legal Entity Registration
1	RJ	Post-consumer kitesurf sail fabric	Jackets	2014	MEI
2	SC	Pre-consumer twill and nylon	Bags and jackets	2016	MEI
3	RJ	Post-consumer denim fabrics	Clothes and accessories	2015	MEI
4	RS	Post-consumer waste: umbrella fabric and tire inner tubes	Jackets, bags, and backpacks	2013	SIMPLES
5	PE	Fabric scraps from clothing manufacturing itself	Clothes and accessories	1992	SIMPLES
6	SC	Post-consumer denim fabrics	Bags and cases for electronics	2019	SIMPLES
7	PR	Industrial and post-consumer textile waste	Bags, backpacks, toiletry bags, and accessories	2013	MEI
8	SP	Industrial and post-consumer textile waste	Clothes, accessories, flip-flops, and slippers	2016	MEI
9	PR	Textile waste from small garment manufacturers and post-consumer waste	Clothes	2013	MEI
10	SC	Post-consumer waste: tire inner tubes, inflatable mattresses, umbrella fabric, and truck tarp	Bags, wallets, and belts	2019	MEI
11	SP	Post-consumer textile waste: used workwear	Blankets and corporate gifts	2014	SIMPLES

Source: Ziegler (2022)

The analysis of the information highlights similarities and differences among the sample companies. Regarding the waste used, there is a predominance of post-consumer materials, although some companies use only pre-consumer waste or a combination of both. The companies are distributed across Brazil's South, Southeast, and Northeast regions, with a higher concentration in the South. In terms of products, some companies produce exclusively clothing or accessories, while others combine both. Most were founded from 2013 onward, and the predominant formalization is MEI, with a smaller share registered under Simples.

3.1 Applied Techniques

This section presents the methodological procedures adopted in the research, including document analysis and semi-structured interviews. The objectives, theoretical references, and steps involved in each approach are detailed below.

Document analysis followed Sá-Silva, Almeida e Guindani (2009), who state that "the document analysis stage aims to produce or re-elaborate knowledge and create new ways of understanding phenomena." In this study, the phenomena were observed through the institutional communication of the sample companies.

The objective of document analysis was to assess the sample's communication according to criteria of environmental, social, and economic sustainability. Document analysis used information from the companies' websites and social media that was publicly available online during the period from 2020 to 2021. These materials were considered documents because they are publicly and unrestrictedly available (Sá-silva; Almeida; Guindani, 2009).

Semi-structured interviews place greater emphasis on the interviewee and their capacity as a specialist in their field of activity (Flick, 2009). The objective of the interview was to map product design development processes using textile waste. The interview guide comprised the questions shown in Table 3.

Table 3 – Interview Script

Interview Script Questions
1 What were your reasons for choosing to use textile waste as raw material in your production?
2 What are the most relevant aspects for defining the new products to be manufactured by your company?
3 Could you detail the stages involved in the product design and development process in your company?
4 Products made from waste may raise consumer doubts regarding their quality and durability. How does your company address the issue of product quality?
5 What forms of communication and interaction does your company use to connect with the public?

Source: Ziegler (2022).

The definition of the questions was based on Flick (2009), using the method proposed by Freitas *et al.* (2021), in which each question is tested for the validity of its objective and its justification for answering the research question and guiding the literature review. For the theoretical framework of the questions, articles

from the fields of product design, design and sustainability, circular and creative economy, and sustainability-oriented marketing were researched.

4 RESULTS

This section presents the main results obtained from document analysis and the semi-structured interviews conducted with entrepreneurs. First, it addresses perceptions derived from the companies' institutional communication, followed by reflections from the interviews, providing a broader understanding of practices related to sustainability and the circular economy.

In the document analysis, it was observed that none of the companies use the term 'creative economy' and that five use the term 'circular economy' in their communication. All discuss the use of waste as raw material.

In the interviews, all questions were answered by the entrepreneurs. Overall, they were aware that they were part of a circular economy, and they even used this term in their speech. It was also observed that they started their ventures by recognizing value in waste and, above all, as citizens, feeling uncomfortable with material waste. This reinforces the positive socio-environmental impact of these entrepreneurs' initiatives.

Based on the above, it is possible to understand that there were two parallel types of analysis: one documentary, derived from research on the companies' websites and social media, and a second consisting of interview results.

Categorization is a data analysis technique that aims to group information obtained from document analysis and/or interviewees' statements, with the objective of extracting elements that help clarify the question to be answered. For Lima (2010), "in categorization, recognizing similarities and differences leads to the creation of new knowledge." This procedure was essential to transform collected data into elements suitable for analysis and discussion.

The categorization of field data was divided into four phases of analysis. The first three phases were conducted separately for the two research techniques: document analysis and interviews. In each phase, categories were organized, reorganized, and elaborated to synthesize information about the sample. Through this synthesis, the aim was to reveal the most elemental categories for understanding themes that facilitate and strengthen the creative and productive process of those who create and produce products from textile waste.

The results of each analysis were organized into categories.

The categories resulting from document analysis (websites of selected companies) were: (1) creative and circular economy; (2) upcycling of textile waste; (3) positive socio-environmental impact; (4) perceived product value; and (5) post-consumption guidance.

The categories resulting from interview analysis were: (A) motivating factors for using textile waste; (B) improved product design; (C) telling a story about the brand; and (D) communication for sustainability and conscious consumption.

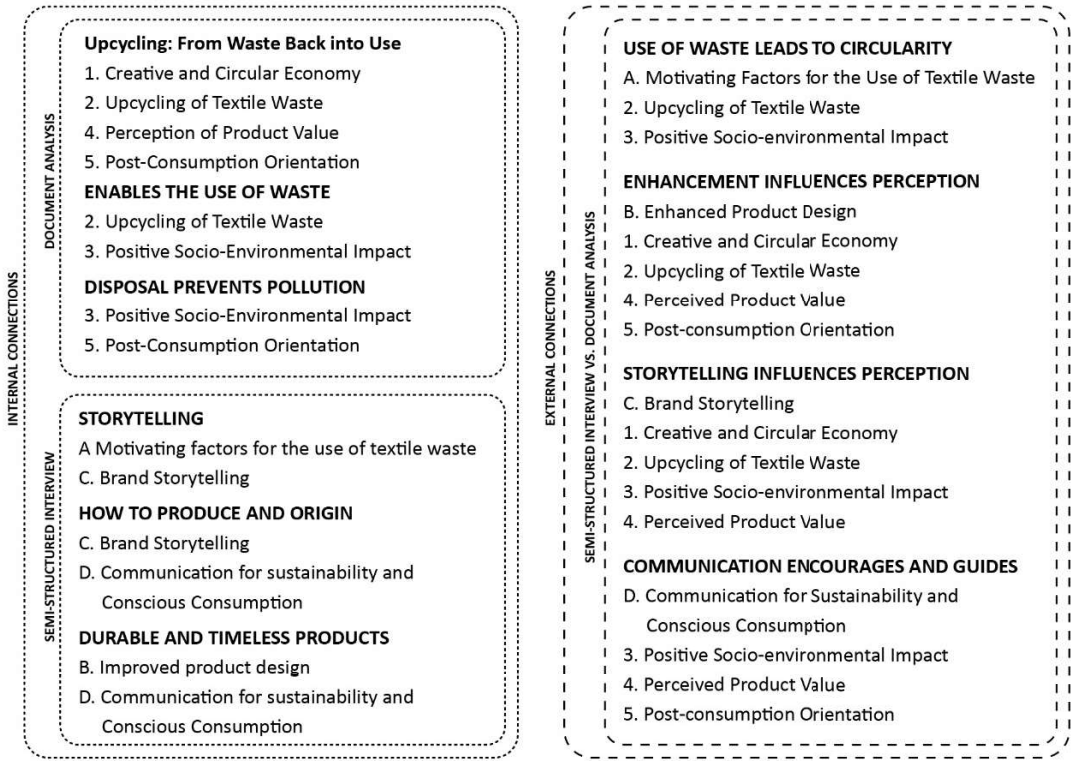
Based on the observation of these categories, a network was designed connecting categories and con-

cepts; interview categories were related to categories identified in document analysis. This category-network exercise follows Flick (2009), who states: "the development of theory involves the formulation of networks of categories or concepts and the relationships between them." The relationship between categories is supported by Strauss e Corbin (1990), cited in Flick (2009), who state: "axial coding is the process of relating subcategories to a category." This made it possible to establish analytical connections between data from different research stages.

The creation of the category network aimed to develop an interpretation to answer the research question: "How can design for sustainability help improve product design in creative and circular economy companies that use textile waste as raw material?"

The next step was to relate the categories to one another. Internal connections (between categories within the same group) and external connections (between categories from different groups) were created. As there were two groups of categories, the result was the identification of three connections, as shown in 1.

Figure 1 – Category Network



Source: Developed by the authors based on Flick (2009).

In the document analysis categories, the following internal connections were found:

Creative and circular economy (1) is linked to upcycling of textile waste (2), perceived product value (4), and post-consumption guidance (5), because upcycling seeks to return materials that would otherwise be discarded to the production chain. Upcycling of textile waste (2) is linked to positive socio-environmental impact (3) because it enables the use of textile waste in product manufacturing that generates income. Positive socio-environmental impact (3) is linked to post-consumption guidance (5) because proper product disposal

avoids environmental pollution.

In the semi-structured specialist interview categories, the following internal connections were found:

Motivating factors for using textile waste (A) is linked to telling a story about the brand (C), because part of the interviewed sample reported that telling the story of the city, the family, or themselves was one of the motivations for undertaking a textile-waste-based business. Telling a story about the brand (C) is linked to communication for sustainability and conscious consumption (D), because how products are made and the origin of the raw material are part of the narrative used to attract new consumers. Improved product design (B) is linked to communication for sustainability and conscious consumption (D) because it directs product projects toward functional, durable, and timeless products that tend to be used for a long time.

Motivating factors for using textile waste (A) is linked to creative and circular economy (1), upcycling of textile waste (2), and positive socio-environmental impact (3), because using waste leads to material circularity and reinsertion into the production chain, and design-based reinsertion is part of the creative economy.

Improved product design (B) is linked to creative and circular economy (1), upcycling of textile waste (2), perceived product value (4), and post-consumption guidance (5), because improved product design—through pattern-making that facilitates the use of scraps and the upcycling of waste—enables the creation of visually attractive and functional products, influencing consumers' perceived value.

Telling a story about the brand (C) is related to creative and circular economy (1), upcycling of textile waste (2), positive socio-environmental impact (3), and perceived product value (4), because products communicate the story of raw materials, the places where companies operate, and the people involved in creation and manufacturing, generating positive social impact and increasing consumers' perceived value.

Communication for sustainability and conscious consumption (D) is related to positive socio-environmental impact (3), perceived product value (4), and post-consumption guidance (5), because through communication companies encourage sustainable practices, inform how the product is made and priced, and provide post-consumption guidance.

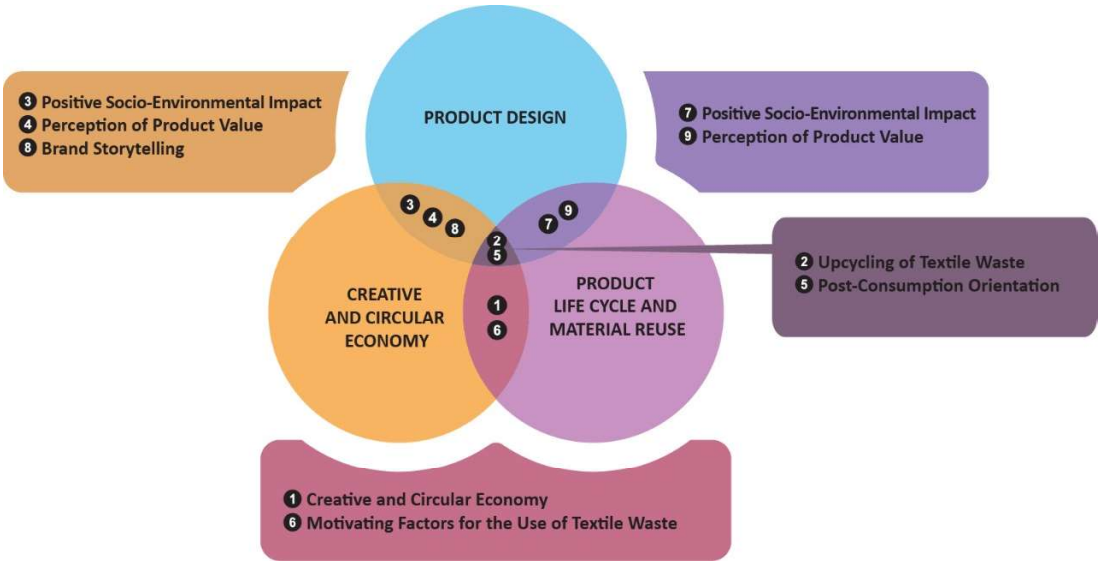
Finally, internal connections derive from relationships among categories within the same group, while external connections derive from relationships between categories from different groups.

Upon concluding the analysis of the category network, it was observed that relationships among the categories created a narrative in which the resulting categories connect to one another and make collective sense. On the other hand, the categorization result became complex, with nine themes in total, making it difficult to confront the categories with the theoretical framework used to support the research. Therefore, it was necessary to synthesize the results by grouping categories with similar meanings. In this sense, Flick (2009) advises that "from this large number of categories that were generated, one selects those that seem most promising for subsequent refinement." This guidance supported the decision to reorganize categories into broader groups.

Analysis of the connections led to the synthesis of the nine initial categories into three major categories compiling themes found in document and interview analyses: (a) product design; (b) creative and circular economy; and (c) product life cycle and material reuse. These three major categories encompass the nine initial categories and their relationships.

Figure 2 presents a diagram with the three final categories and the distribution of the nine initial categories in their intersections, highlighting how the themes are linked.

Figure 2 – Diagram of Category Synthesis.



Source: Diagram of Category Synthesis.

The diagram illustrates the connections among product design, the creative and circular economy, and product life cycle and material reuse, with the nine subcategories, showing the areas in which they are situated and how the set of themes is relevant to the development of sustainable products.

For example, the initial categories upcycling of textile waste (2) and post-consumption guidance are involved with all three final categories. Upcycling of textile waste depends on the creative and circular economy for access to materials in good condition, which is facilitated by post-consumption guidance. In turn, product life cycle and material reuse depends on product design to develop artifacts linked to the three dimensions of sustainability.

5 DISCUSSION

The categories creative and circular economy, product life cycle and material reuse, and product design dialogue with one another and are foundations for the development of sustainable products. The circular economy is a way to close product life cycle; that is, materials left over from industrial production—and even the products themselves—return to the production chain as raw material.

According to the interviewed sample, there is “concern for a second life cycle for the material” (Company 1 statement). There is also a desire to reuse materials, extending their life cycle: “bothered by the amount of waste generated individually and in industry, we began to study the materials and realized the feasibility of replacing leather with tire inner tubes” (Company 4 statement).

In line with this, the creative economy and product design are means to achieve material circularity and extend product life cycles. Product design plays a fundamental role in the durability of an artifact, both physically and aesthetically. For products made from textile waste, there are challenges inherent to the raw material. One interviewee noted: “how do you make a jacket from an umbrella? The material and the format determined the pattern” (Company 4 statement). Interviews also identified the importance of design in “telling a story so the consumer truly understands that it is not a byproduct, but a new product, like any other, with the added value of sustainability” (Company 5 statement).

In creation using waste, the material is already available, and a project is developed to fit it. Tests and redesigns are necessary until the ideal design for the raw material is reached. According to Company 4, in creating their products, “everything starts from the waste; from it comes the research, then the prototype, then laboratory and use tests.” The entrepreneur also emphasized that because they use materials originally intended for other purposes, they need to test more than conventional products.

A product with good physical quality and an ‘timeless’ design tends to be used longer, reducing negative environmental impacts generated by disposal. Regarding design’s responsibility in reducing environmental impacts, Manzini (2008) states that sustainability should be the meta-objective of all design research, since who could declare a desire to design or research in a way that produces unsustainability?

6 CONCLUSION

The data collected confirm that the industrial textile sector is highly polluting. Added to this is the problem of generally deficient solid waste management, the lack of data on the amount of textile waste generated, and the share that is reused and recycled. Even so, companies are opening space for the development of products made from textile waste and are seeking to prosper in a market that is not yet consolidated but is growing, driven by consumer demand for sustainable products.

The qualitative method used in the investigation was appropriate because it enabled an understanding of the sector’s entrepreneurs’ values and needs. Through document analysis, it was possible to learn what the companies communicate to the public and how they want to be seen; interviews, in turn, enabled deeper understanding of the types of textile waste reused, the design methodologies employed, and the difficulties faced by each entrepreneur.

The results led to the identification of aspects that partially helped answer the research question. For example, companies that value the specificities of the raw materials they use tend to create products that—even as part of a production line—are perceived as unique by their customers. This is the case of Company 1, which reuses kitesurf sail fabric to manufacture jackets, and Company 4, which reuses umbrella fabrics and tire inner tubes to manufacture jackets, bags, and backpacks.

Considering what was learned about the sample, it is unlikely that a single methodology could meet the needs of this entire population, since its main characteristic is diversity. None of the eleven companies produces the same product or reuses the same type of waste. Even if that were to occur, aspects such as

machinery, available labor, and the consumer audience would also differ, making it impossible to standardize guidance on how to develop product design using textile waste.

The use of textile waste in manufacturing is a growing field; among the eleven companies surveyed, only one has a family tradition and has been established for over two decades. Consequently, there is a clear need to equip entrepreneurs venturing into waste-based production with the necessary expertise, enabling them to develop their own solutions or identify the appropriate professionals to consult.

It can be said that the entrepreneurs in the sample are pioneers in founding businesses that use waste as raw material. This subject is relatively new, with most companies having between two and seven years of operation at the time of the research. Another observed aspect supporting relevance is proximity to industries in the case of those using pre-consumer waste, and proximity to disposal sites in the case of those using post-consumer waste. This indicates the need to create alternatives that facilitate environmentally appropriate and efficient destinations for textile waste.

Ultimately, design—as an integral component of the creative economy—emerges as a pivotal discipline for developing sustainable products and fostering eco-friendly production processes. Within the surveyed companies, the designer's role transcends mere project execution, evolving into that of an entrepreneur and strategic decision-maker. However, these professionals do not operate in isolation; fostering sustainability-oriented social networks is essential for catalyzing 'systemic discontinuity' (Manzini; Vezzoli, 2016). This paradigm shift involves transitioning from a model of unlimited growth in production and consumption toward a development framework focused on reducing material throughput while simultaneously strengthening social cohesion, preserving cultural diversity, and regenerating ecological systems. Manzini posits that envisioning alternative futures beyond current unsustainable production and consumption patterns is attainable. However, the preservation and regeneration of socio-environmental capital necessitates a fundamental departure from prevailing economic paradigms. The current model—underpinned by the logic of resource extraction and linear growth—is inherently at odds with the regenerative capacity of living systems, thereby demanding a systemic transition in both lifestyles and production frameworks.

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