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**CONTATO**

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# SOBRE O PERIÓDICO MIX SUSTENTÁVEL

O Periódico Mix Sustentável nasceu da premissa de que o projeto englobando os preceitos da sustentabilidade é a única solução possível para que ocorra a união entre a filosofia da melhoria contínua com a necessidade cada vez maior de preservação dos recursos naturais e incremento na qualidade de vida do homem. A sustentabilidade carece de uma discussão profunda para difundir pesquisas e ações da comunidade acadêmica, que tem criado tecnologias menos degradantes na dimensão ambiental; mais econômicas e que ajudam a demover injustiças sociais a muito estabelecidas.
O periódico Mix Sustentável apresenta como proposta a publicação de resultados de pesquisas e projetos, de forma virtual e impressa, com enfoque no tema sustentabilidade. Buscando a troca de informações entre pesquisadores da área vinculados a programas de pós-graduação, abre espaço, ainda, para a divulgação de profissionais inseridos no mercado de trabalho, além de entrevistas com pesquisadores nacionais e estrangeiros. Além disso publica resumos de teses, dissertações e trabalhos de conclusão de curso defendidos, tendo em vista a importância da produção projetual e não apenas textual.
De cunho essencialmente interdisciplinar, a Mix tem como público-alvo pesquisadores e profissionais da Arquitetura e Urbanismo, Design e Engenharias. De acordo com a CAPES (2013), a área Interdisciplinar no contexto da pós-graduação, decorreu da necessidade de solucionar novos problemas que emergem no mundo contemporâneo, de diferentes naturezas e com variados níveis de complexidade, muitas vezes decorrentes do próprio avanço dos conhecimentos científicos e tecnológicos. A natureza complexa de tais problemas requer diálogos não só entre disciplinas próximas, dentro da mesma área do conhecimento, mas entre disciplinas de áreas diferentes, bem como entre saberes disciplinares e não disciplinares. Decorre daí a relevância de novas formas de produção de conhecimento e formação de recursos humanos, que assumam como objeto de investigação fenômenos que se colocam entre fronteiras disciplinares.
Desafios teóricos e metodológicos se apresentam para diferentes campos de saber. Novas formas de produção produção de conhecimento enriquecem e ampliam o campo das ciências pela exigência da incorporação de uma racionalidade mais ampla, que extrapola o pensamento estritamente disciplinar e sua metodologia de compartimentação e redução de objetos. Se o pensamento disciplinar, por um lado, confere avanços à ciência e tecnologia, por outro, os desdobramentos oriundos dos diversos campos do conhecimento são geradores de diferentes níveis de complexidade e requerem diálogos mais amplos, entre e além das disciplinas.
A Revista Mix Sustentável se insere, portanto, na Área Interdisciplinar (área 45), tendo como áreas do conhecimento secundárias a Arquitetura, Urbanismo e Design (área 29), a Engenharia Civil (área 10) e, ainda, as engenharias em geral.

## CLASSIFICAÇÃO QUALIS

No quadriênio 2017-2020 a revista MIX Sustentável está classificada como A3 em todas as áreas de avaliação.

## MISSÃO

Publicar resultados de pesquisas e projetos, de forma virtual e impressa, com enfoque no tema sustentabilidade, buscando a disseminação do conhecimento e a troca de informações entre acadêmicos, profissionais e pesquisadores da área vinculados a programas de pós-graduação.

## OBJETIVO

Disseminar o conhecimento sobre sustentabilidade aplicada à projetos de engenharia, arquitetura e design.

## POLÍTICAS DE SEÇÃO E SUBMISSÃO

### A) Seção Científica

Contém artigos científicos para socializar a produção acadêmica buscando a valorização da pesquisa, do ensino e da extensão. Reúne 12 artigos científicos que apresentam o inter-relacionamento do tema sustentabilidade em projetos

de forma interdisciplinar, englobando as áreas do design, engenharia e arquitetura. As submissões são realizadas em fluxo contínuo em processo de revisão por pares. A revista é indexada em sumários.org e no google acadêmico.

**B) Seção Resumo de Trabalhos de Conclusão de Curso de Graduação, Iniciação Científica e Pós-graduação**
Tem como objetivo a divulgação de Teses, Dissertações e Trabalhos de Conclusão de Curso na forma de resumos expandidos e como forma de estimular a divulgação de trabalhos acadêmico-científicos voltados ao projeto para a sustentabilidade.

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É um espaço para resenhas e entrevistas (espaços de diálogo). Apresenta pelo menos duas entrevistas com profissionais atuantes no mercado ou pesquisadores de renome, mostrando projetos práticos que tenham aplicações na esfera da sustentabilidade. Deverá ainda disponibilizar conversas com especialistas em sustentabilidade e/ou outros campos do saber. Todas os números possuem o Editorial, um espaço reservado para a apresentação das edições e comunicação com os editores.

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# SUMÁRIO

## ARTIGOS

# EDITORIAL

## MIX SUSTENTÁVEL VOL. 10 N. 2 – EDIÇÃO ESPECIAL

## SUSTAINABLE DESIGN SYMPOSIUM 2023

In this edition Mix Sustentável presents a set of papers that received the highest scores by ad hoc reviewers during the submission process at the Sustainable Design Symposium 2023 (SDS2023), which occurred at Santa Catarina Federal University between 1st and 3rd December 2023. It provides the reader a glimpse of the broad spectrum of themes that is tackled by the Design Research community, which is in tune with the high complexity associated with the search for a more sustainable society.

Whilst many topics present a growing maturity and consolidation, both from a theoretical as well as methodological perspective, the efforts of the authors show clearly an attempt to spread and test out their applications across different sectors of the economy as well as different social contexts. Sustainable design research on those papers is clearly concerned with the actual implementation issues, providing viable and effective responses to contemporary social, environmental and economic challenges. This is the case of papers that investigate issues around materials and manufacturing/building processes, such as the work of Sasaoka, Pereira and Souza (2024) on the use of bamboo to produce lamps within a local community; the work of Calei e Librelotto (2024) assessing the culture and history of natural materials in the context of the vernacular architecture in Angola; the work of Sampaio et al. (2024) demonstrating practical applications of 3D printing in the health sector; the proposal of Zeni et al. (2024) on strategies to reduce the environmental impact of packaging through system design. These studies bring new light into the role of Design to value local wisdom and culture on materials and associated processes and, at the same time, the potential role of Design to push forward the frontiers of existing knowledge.

The current generation of Designers is already facing gigantic challenges, particularly regarding the urge for climate change mitigation, higher social equity and cohesion and the crying need for implementing a greener economy. Creativity is more important than never to develop innovative sustainable solutions, including those beyond the anthropocentric paradigm. The work of Melo et al. (2024), for instance, looks into the issue of a creativity by reporting a ceramic design workshop with the intent of valuing the knowledge and competencies within a territory; the work of Silva, Arruda & Silva (2024) investigates the issue of creativity by discussing the role of bioinspiration as a basis for innovation in surface design. Emerging research themes such as the role of A.I. when creating solutions towards sustainability; the challenge of co-creating solutions with/for other forms of life; the integration of existing creativity competencies within traditional communities, etc, illustrate the vast challenges presented to the research community in order to potentialize this central and crucial competence of Designers and of the Design field.

Despite the generalized increase in awareness about the emergency of implementing actions towards more sustainable patterns of production and consumption, pushed by the growing number of extreme weather events around the world, there is also a recognized urgency to speeding up the development of competencies on sustainability among Design students and professionals. The selected papers do show such concern, with results of various research projects around the issue of Design Education. Ferroli et al. (2024) provides a critical analysis of the educational training content within Design courses from the perspective of the Environmental Dimension of sustainability; Garcia e Franzato (2024) adds further discussion on the issue by analysing the future of Design from a social-environmental perspective. Some of the papers provide propositions on tools and approaches to enable more effective education of current/future designers regarding sustainability, such as the work of Ferroli & Librelotto (2024) which debates the use of material library as a means for achieving the environmental education of Designers, or the work of Santos, Pfeiffer & Gonçalves (2024) that demonstrates the use of a urban garden project as a project-based approach for sustainability education.

Besides of looking for innovative solutions for the present, the papers on this edition also provide some light into contributions of the design field to devise solutions for the long term. The research reported by Franzato et al. (2024) provides a good example of such contribution, with the use of Design competencies to develop scenarios and ecotopias within a socio-environmental design laboratory. Notice that even those papers that look into the situation of the present, such as the work of Araújo, Clementindo & Torres (2024), which provides a panorama and guidelines for the use of digital manufacturing in the Brazilian context, also provide foundations for those interested in developing wider policies, programs and projects. Important to notice that the past is prologue and can provide wisdom on our future directions, helping to inspire designers and other professionals when conceiving products, services and systems. For that matter, this issue

presents the work of Fiorin, Rodrigues & Lopez (2024) that investigates the landscape of marine-industrial production in the city of Florianópolis, presenting lessons learnt from the Arataca shipyard.

Human behaviour towards sustainability remains a relevant research topic in the Design field, and the drastic changes in the patterns of consumption and production required to mitigate climate change is likely to maintain it high in the research agenda. This edition presents the paper of Dantas et al. (2024) that investigates behaviour towards sustainable consumption within the fashion sector in Brazil. It also presents the work of Medeiros et al. (2024) that looks into the behaviour issue from the perspective of the social dimension of sustainability: graphic design contribution to prevent violence within a public school.

Finally, consistent with the previous editions, the environmental dimension receives more attention from the Design community, followed by the social dimension. Yet, the papers presented in this edition show more multidimensional approaches towards sustainability, even when it is the social dimension that underpins the initiative. The paper of Custódio, Santos & Barata (2024), for instance, investigates the Housing First concept for homeless people, which clearly entails economic, environmental concerns, despite its focus on the social dimension; the work of Costa, Arruda & Oliveira (2024) provided an "humanized analysis" of popular housing through 14 biophilic patterns.

The breadth of themes on this edition might contribute for those searching for inspiration on the role of Design and Designers on the search for a more sustainable planet. It is also a testimony of the relevant impact that the field can provoke in a variety of contexts and challenges. It clearly illustrates how essential is the field of Design to articulate a multi/interdisciplinary perspective in order to tackle the great challenges presented by sustainability.

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# BAMBOO LANTERN FESTIVAL: A SOCIAL DESIGN EXPERIENCE INTEGRATING THE UNIVERSITY AND THE LOCAL COMMUNITY

## *UMA EXPERIÊNCIA DE DESIGN SOCIAL: CRIAÇÃO E PRODUÇÃO DE LANTERNAS DE BAMBU NO CONTEXTO DA UNIVERSIDADE E COMUNIDADE LOCAL*

## *FESTIVAL DE LINTERNAS DE BAMBÚ: UNA EXPERIENCIA DE DISEÑO SOCIAL INTEGRANDO LA UNIVERSIDAD Y LA COMUNIDAD LOCAL*

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**ABSTRACT**
Environmental degradation and global social inequality require an education focused on transforming values and practices in today's world. Bamboo, both as a plant and a material, has mitigated the impacts of climate change. Combined with design within a bamboo productive chain, it also enhances the possibility of a pedagogical dimension for design students and the participation of local communities. This study aims to examine how social design can collaborate in education for sustainability, involving the researcher's participant observation and co-creation, which resulted in the Take Akari Bamboo Lantern Workshop, held at the Unesp Campus in Bauru/SP. Results show that social design combined with bamboo helps in motivating people to internalize and carry out new practices due to the collaborative and collective ways of working collectively based on which it was held, and is capable of transforming scenarios and changing beliefs and values.

**KEYWORDS**
Social Design; Bamboo; Education for Sustainability

***RESUMO***
*A degradação ambiental e a desigualdade social global solicitam a busca por uma educação para a transformação de valores e práticas no mundo atual. Nesse contexto, o bambu, como planta e material, tem mitigado os impactos das mudanças climáticas. Quando combinado com o design dentro de uma cadeia produtiva como a do bambu, aumenta as possibilidades pedagógicas tanto para os estudantes de design, quanto nos processos de participação das comunidades locais. Este estudo tem como objetivo analisar como o design social pode colaborar na educação para a sustentabilidade envolvendo a observação participante e a cocriação de pesquisadores, durante a Oficina Take Akari Lanterna de Bambu, realizada no Campus da Unesp em Bauru/SP. Os resultados mostram que o design social aliado ao bambu ajuda, devido às formas colaborativas e coletivas de trabalho, a motivar as pessoas a internalizarem e realizarem novas práticas, capazes de mudar crenças, valores e transformar cenários.*



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***PALAVRAS-CHAVE***
*Design social; Bambu; Educação para sustentabilidade*

***RESUMEN***
*La degradación ambiental y la desigualdad social global requieren una educación enfocada en transformar valores y prácticas en el mundo actual. El bambú, como planta y material, ha mitigado los impactos del cambio climático. Combinado con el diseño dentro de una cadena productiva de bambú, también mejora la posibilidad de una dimensión pedagógica para los estudiantes de diseño y la participación de las comunidades locales. Este estudio tiene como objetivo examinar cómo el diseño social puede colaborar en la educación para la sostenibilidad, involucrando la observación participante y la co-creación del investigador, que resultó en el Taller Take Akari Bamboo Lantern, realizado en el Campus de la Unesp en Bauru/SP. Los resultados muestran que el diseño social combinado con el bambú ayuda a motivar a las personas a internalizar y realizar nuevas prácticas debido a las formas colaborativas y colectivas de trabajo en base a las cuales se realizó, y es capaz de transformar escenarios y cambiar creencias y valores.*

***PALABRAS CLAVE***
*Diseño social; bambú; educación para la sostenibilidad*



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## 1. INTRODUCTION

The urgency for a change of vision in favor of a non-anthropocentric mindset, one in which human beings are able to see themselves as being an integrated part of nature, is even greater nowadays, considering the present environmental crisis. It is essential, therefore, to assume a proactive and systemic approach to social design by pooling efforts, knowledge, skills and methods, making way for a more collaborative, fair, and resilient future.

With this in mind, the Take Akari Bamboo Lantern Workshop and Festival was conceived at the Faculty of Design and Engineering of the Unesp (São Paulo State University) Bauru Campus. Its aim was to generate social integration and the sharing of experiences among extension and non-extension students, residents of the Horto de Aimorés Rural Settlement, Bauru/SP's local community and participants from other neighboring cities.

The event was conceived thanks to the existing infrastructure of the Laboratory for Research and Experimentation with Bamboo - LEB and the Didactic Laboratory for Materials and Prototypes - LDMP, both based at Unesp - Bauru Campus.

LEB was founded in 1990 as part of the Bamboo Project by Professor Marco Pereira from the Faculty of Mechanical Engineering at Unesp. In this Laboratory, the Taquara Project's extension activities, based on sustainable design, have been carried out since 2009. By this means the dissemination of the culture of bamboo as a renewable raw material is introduced through training workshops in product development, carpentry techniques using bamboo in its natural or processed form, construction systems, and the generation and propagation of species. The university extension called Taquara Project has had the participation of over a hundred students who worked with rural communities, public schools, universities and the public in general. All of its activities, carried out through lectures and workshops, involve the bamboo production chain: from the harvesting of culms, production of seedlings, preventive treatments of culms, processing, the making of products, to structures needed for construction.

In the context of this laboratory, the Take Akari Bamboo Lantern workshop and festival was held in February 2020.

Take-Akari is a bamboo lantern lit by a candle or LED (Light Emitting Diode), so the Take Akari Lantern Festival literally means the Illuminated Bamboo Lantern Festival. It was originally conceived by the Chikaken group in the Kumamoto prefecture of Japan in 2007, and consists in the preparation of bamboo material for the assembly of lanterns and their collective creation, which has been held in communities around that region of Japan.

Matsuri is the Japanese word for festival and is derived from the verb matsuru, which means "to worship or show reverence". This specific object of worship for the Japanese has its origin in the native gods kami, and it is a respectful form of address, representing the communion between the gods and the community (Lee, 2013, p. 165). In Japan, traditional Matsuri festivals are known to be held till today, but are now adapted to the new social conformations and demographic conditions and with a focus on community participation, being therefore less religiously based than before (Lee, 2013). In this current context, the Chikaken Group has conceived new festival proposals resulting in a contemporary Matsuri, engaging a large number of participants and generating a communal festival experience.

Based on this, Take-Akari projects are now established as local interventions mainly focusing on stimulating the creation of networks of people, as well as serving as a strategy for attracting tourists to those areas, which until then had remained almost abandoned. With the premise of "bringing people together; connecting them to communities and to interactions with nature" (Ikeda; Mishiro, 2021), the festivals mobilize people from those communities, beginning with the preparation phase and ending with the consecration of the lanterns, which are installed and lit by LEDs. The strong potential for attracting tourists recurrent events like these have, has already been noted, and is enhanced by their ritualistic and visually symbolic characteristics. This proposition also defends the perspective that bamboo is an easily accessible material that can be cut and worked by anyone.

The Chikaken group in particular, is currently involved in several projects that engage in community development as well as in environmental protection and education for sustainability (Ikeda; Mishiro, 2021). It currently has five members and seven employees and its work consists of designing, producing and installing Take-Akari, as well as holding events and workshops in various cities of Japan and also in other countries, such as China, Taiwan, the USA, the Philippines and Brazil, among others.

The Chikaken team, based in the Kumamoto Prefecture, Japan, develops their work inspired by the Usuki Takeyoi Festival in the southern region of Kyushu, Japan, where bamboo is abundantly produced, but where, due to an emphasis on industrialization, bamboo forests have been abandoned and unused, coupled with

a traditional tourism system which is unable to meet the requirements of these new times.

When asked to create lantern scenes in urban centers they attempt to conceive the work in such a way that the lanterns become an integral part of the environment, enabling its inhabitants to recognize bamboo as a local value. They also try to establish a dialog with community leaders in order to identify new needs and elements that might be added to subsequent events. Financial resources have to exist for the workshops and festivals to be held, and that requires a search for support and sponsorship and sometimes the charging of a registration fee for those who wish to take part in them; in some cases, DIY video tutorials on how to make the pieces are offered to the public in order to support their participation.

In any case, the design of the lanterns is based on traditional or non-traditional references and can be created by festival participants, valuing the importance of people to be able to recognize themselves in them. After use, the lanterns may be transformed into objects of use or be made into charcoal, crushed fertilizer or biomass (Matsumoto; Guiotoko, 2020).

## 2. METHODOLOGICAL PROCEDURES

Considering that a project based on social design is made up of four basic strategies - diagnosis or recognition of its context, articulation, social learning and the construction of the notion of autonomy (Galán, 2011; Disalvo et al., 2011; Chené, 1983), this work's project was also anchored in two complementary supports: bamboo and collective work.
Those two domains are found in almost every stage of the bamboo production chain that has been in place at Unesp - Bauru Campus since 1990, from the introduction and planting of species, their management, culm production, physical, mechanical and hydraulic characterization, as well as the processing and development of products, constructions and light structures and even community training and extension activities. Figure 1 shows the diagram of the Bamboo Project production chain.

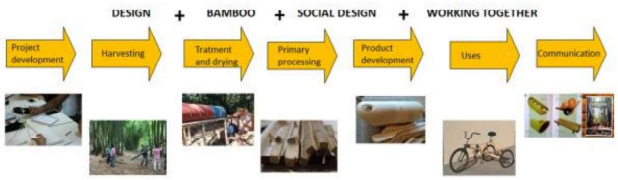


**Figure 1:** Bamboo Project production chain.
**Source:** Silvia Sasaoka (2021).

The project for this festival was designed for a maximum of 32 people involved in the production of 300 bamboo lanterns and three days were needed for the pieces to be made and installed. The precise planning of its production process had to be done a few months in advance, as detailed below.

## 3. DEVELOPMENT

The workshop and festival planning began in August 2019 with the objective of establishing an intercultural dialogue between Brazil and Japan using bamboo as a vehicle, in keeping with the social approach undertaken by the Japan Foundation – a Japanese government agency based in São Paulo City, which was then recently under new management. Through partnerships between the Japanese organization, FEB - Bauru's Faculty of Engineering - and FAAC - Faculty of Art, Architecture, Communication and Design, the project was also supported by the Japanese-Brazilian Association of Bauru, Sesc Bauru and volunteers from Unesp's Taquara Project. Based on previous work, the first author of this article also identified among her partners the contact of Hiroyuki Hashiguchi, a researcher and curator of bamboo in Japan and Asia who had already worked with the Chikaken group on other Take Akari Bamboo Lantern festivals.

From the dialogue between representatives of the organizing institutions, the curator from Japan and the author mentioned above, the presentation of the cultural dimension of bamboo was recognized as a representation from which both the participants and the local public could make contact with the value of this plant and material, determined by the social and cultural meanings associated with the lanterns. Furthermore, it was not a question of simply mimicking what had already been done but of creating a scenario specifically adapted to the local conditions, helping to determine which species of plant were most adequate, the type of work the participants would engage with, the infrastructure and techniques required, integrating as well the aesthetic conceptions of the local population.

The event itself could take place in mid-February 2020, three weeks before all social activities came to a halt due to the Covid-19 pandemic.

As for the creative process, due to the short timeframe available for carrying out all the activities required, it was decided that the designs on the walls of the stalks, which would have holes in them, would be developed in Japan by the Chikaken group itself. Figure 2 shows a sketch they

made, in which the final shape of the installed lanterns is organized and designed to have a visual impact. That way a strict control over the final result they wished to achieve through the project was assured. And next to it, in Figure 3, the drawings indicate small circles of varying sizes, a reference to the number of the drill bit to be used for drilling.

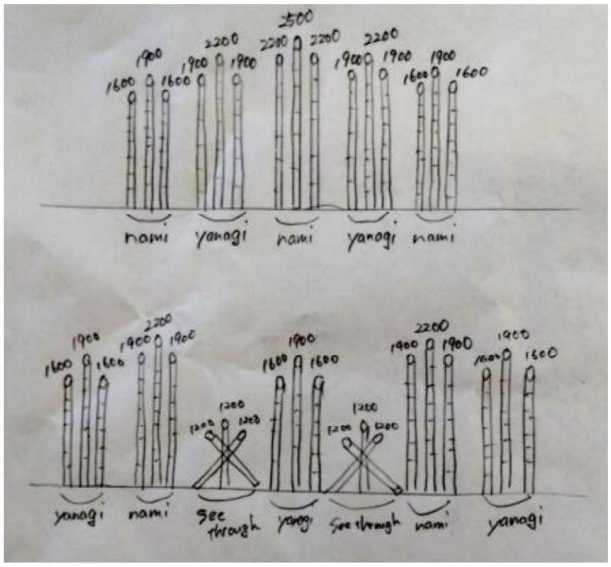


**Figure 2:** Drawings developed by the Chikaken Group.
**Source:** Personal collection of Silvia Sasaoka (2020).

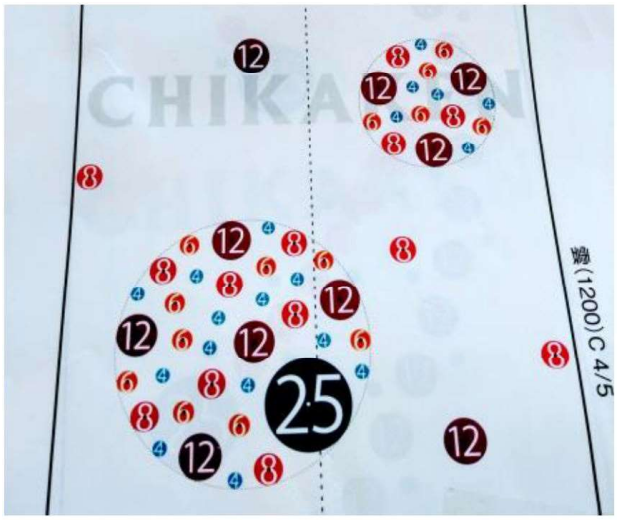


**Figure 3:** Project for drilling the lanterns.
**Source:** Personal collection of Silvia Sasaoka (2020).

Figure 4 shows the thatch fixed to the workbench with an attached mold with drawings to guide the drilling of the lanterns.

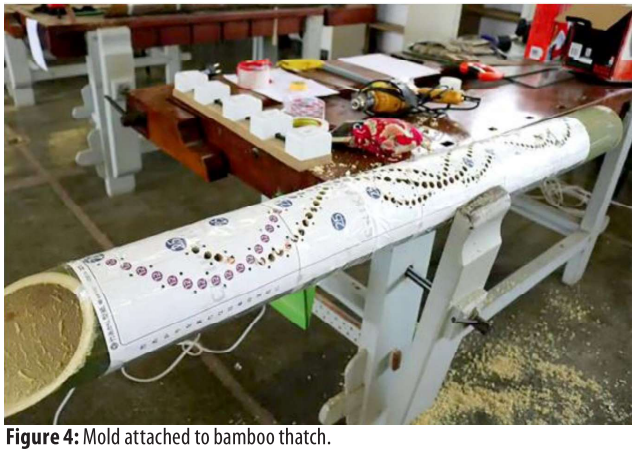

**Figure 4:** Mold attached to bamboo thatch.
**Source:** Personal collection of Silvia Sasaoka (2020).

For the installation of the lanterns after completion we chose the university campus's main square, the Praça do Bosque (n.t. 'Woods Square') considering its location in front of the University Library, which means it's a transit area for almost everyone on campus, including visitors who attend the institution. For the installation to be possible the Chikaken group received images and a plan showing the dimensions of the area from various angles. The group then sent a project with a list of requirements, quantities of stalks and lanterns, as well as other useful information.

With regard to the guidelines and preparation of the culms, their harvesting began two weeks before the Chikaken group arrived in Brazil, with the support of volunteers from the postgraduate course in design and architecture, the Clube Nipo-Brasileiro de Bauru (n.t. a Japan-Brazil Club situated in the city of Bauru - São Paulo) and former members of the Taquara group- a team of six people harvested 100 culms of the Dendrocalamus Asper bamboo species over a period of 3 days.

## 4. RESULTS

The guidelines for cutting the culms sent from Japan were based on the Phyllostachys Pubescens species, the Mossô, which is the most common bamboo in Japan, as shown in Figure 5. Therefore, due to the difference between the two species (Phyllostachys Pubescens Dendrocalamus Asper) in terms of the diameter and wall thickness of the culms, many adaptations had to be improvised by the Chikaken team, on site.

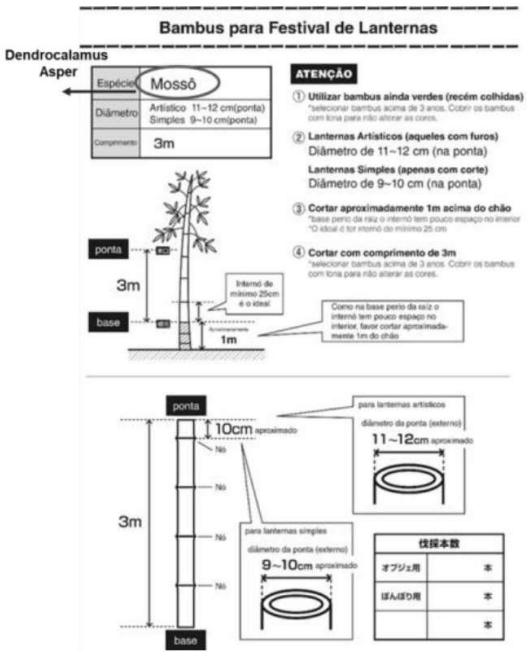


**Figure 5:** Tutorial for cutting the stalks. Source: Chikaken Group - translated by Roni Guitoko (2020).
**Source:** Personal collection of Silvia Sasaoka (2020).

After harvesting and washing the stalks, a preservative treatment was carried out at the same place the harvest took place in the agricultural area of the LEB - Bamboo Experimentation Laboratory. The 100 stalks were washed one by one with a high-pressure washer and then given a preservative treatment by immersing them in a solution of water-soluble salts.

In order to move and store the stalks and to process the bamboo and produce the lanterns, the support of a university transport truck had to be summoned. The Bamboo Project also established a partnership with the LDMP - Laboratory of Molds and Prototypes, which involved the collective work of more than 30 workshop participants.

Two months in advance, the Chikaken group sent a list of specific tools and equipment needed for each operation in the production of bamboo lanterns as well as recommendations, which were followed by the team involved:

To light the bamboos with LEDs the bamboo's diaphragms were removed with a steel rod approximately 3 meters long;

To adjust the length of the lanterns a bench saw (380 mm), a tape measure, marking pens, a long extension cord, a tarpaulin, gloves and a bamboo saw were used;

To drill the bamboo in order to install internal lighting, an impact drill, a glass saw (75 mm) and a screwdriver were used;

Before drilling the stalks, however, a piece of paper printed with the design of the surface to be illuminated was glued along the surface of each one of them.

Then, to illuminate the culms from the inside, hollow designs were formed drilling holes with a corded impact drill, a 4-12 mm bamboo drill bit, a 15-30 mm wave cutter and a 45-60 mm glass saw.

The splinters were cleaned using pliers, a long-handled brush, a stylus and an air compressor;

The following were used to assemble the structures to the lanterns: cordless impact drill, positive screwdriver bit, 2.5 mm drill bit, 30 mm fine screw, 25x650 mm bamboo slats, 25x900 mm bamboo slats, knife and rubber hammer;

Garbage bags, brooms, dustpans and industrial vacuum cleaners were used to clean the space;

To assemble the electrical installations with LEDs, different thicknesses of wire had to be used, more than 60 continuous meters for each lantern, and the LEDs were fixed to wooden or bamboo poles. These installations were produced in series.

Once ready, the lanterns were finally transported from the LDMP workshop to the campus woods to be installed before sunset. A team took care of the planned electrical installations and connections, and all the cabling was used and tested. The formalized act of lighting the lanterns could then take on its symbolic dimensions, since it is characterized as a rite. To present this rite to the public, the opening of the event was determined to take place specifically at sunset. Synchronized to the Japanese drums of the Taiko group played by members of the Japanese-Brazilian Club of Bauru, the 300 lanterns' LED installations were lit, outlining the woodland with lights and shadows. The public, made up of the local and regional community, reacted to the scene with wondrous applause, and the project's 32 participants were able to enjoy the intense work they invested in this workshop as creators of the lights. Figure 6 shows the lanterns installed in the central area of the woodland square. Figure 7 shows a different arrangement of lanterns in the same place.

This three-day workshop brought together a diverse group of people, including members of the Viverde Agro Ecological Association, residents of the Horto de Aimorés settlement, Japan Foundation's technical team, Bamboo Project researchers, former students and extension workers from the Taquara Project, volunteers from the Japanese-Brazilian Club and members of the Chikaken group, the main objective being to learn a variety of techniques using bamboo and to experience the different functions this work entails.

**Figure 6:** Opening of the event at Unesp - Bauru Campus).
**Source:** Photograph by Thaís Ueno (2020).

**Figure 6:** - Arrangement of lanterns in the central area of the woodland square at Unesp - Bauru Campus.
**Source:** Photograph by Thaís Ueno (2020).

## 5. ANALYSIS OF RESULTS

As a guide for the analysis of this case study and the interpretation of its data, we used the normative framework adapted from Safoutin et al. (2000) to identify social design processes. The starting point for the gathering of information and the criteria for observation of the progressive development of a project with a defined beginning and end was as follows: the many forms of organization and planning; the process of establishing partnerships and identifying needs; the aesthetic and functional concepts adopted; the forms of cooperation or intensity of engagement; social learning or exchange and learning experiences; and autonomy inducing processes.

The results of this study show that the stages developed for the Take Akari Bamboo Lantern Workshop and Festival at Unesp - Bauru Campus are in line with the main characteristics of social design, which consist of the designing of social processes with a focus on social integration.

The design of social processes in this workshop was considered right from the start, in the conception and planning of the project. The articulation of partnerships was part of this stage, including institutional, individual and collective forms of cooperation. With the information provided by representatives of the institutions involved in the work, the design of the production process was scaled according to the number and characteristics of the participants. It should be noted that this social group was made up of people with different backgrounds, experiences and knowledge, which tested the balance between the different interpersonal relationships and the sense of belonging of each person in relation to this new working community. And so, with these human and material resources available, it was possible to find forms of organization that focused more on abilities than disabilities, which was encouraged by a sharing of power in carrying out the work.

In this sense, as demand in the bamboo production chain started to get organized, teams and individuals were spontaneously arranged, and took responsibility for the harvesting and processing of the bamboo groves, the transport logistics (loading and unloading of stalks); providing the infrastructure for processing the bamboo and the distribution of tools in the college's carpentry workshop; and for assembling and installing the lanterns. Practical experience has shown that forms of cooperation have occurred naturally between individuals, which is also attributable to the fact that, due to the culture of collective work in general, to the one that existed in the Bamboo Project as well as the previous experiences in the field of collective work of the Chikaken group, cooperation emerged in a context of stability considering the infrastructure and knowledge of the technical team, which guaranteed a swift transfer of technology to all participants. The technical mastery of bamboo and the methods and procedures for cutting, drilling and cleaning the culms applied in the collective work by the workshop conductors (Chikaken) had an impact on the participants' willingness to learn new production techniques. The way in which roles were distributed, structured according to the skills required, helped to promote a harmonious environment which enabled positive teaching and learning relationships, increasing confidence in learning.

Challenges initially emerged in the workshop, with a series of unprecedented situations in the production process. The Phyllostachys Pubescens species had until then been part of the usual repertoire of work carried out by Chikaken in other countries, while the Dendrocalamus asper species, found in the Bamboo Project's agricultural area, with its thicker, harder and heavier walls, had to be tackled by them for the first time. An adaptation of their previous knowledge to the new conditions was therefore needed. Thus, some steps were added to the lantern production process and new techniques were tested to

achieve the desired finish. These adjustment procedures were shared with all the participants, helping to broaden their aesthetic perception of the levels of demand for this learning. In this respect, Munari (1993) points out that adversity stimulates the search for new opportunities in design, which expands to other forms of "knowledge construction, sensitivity in creation, production and construction" (Munari, 1993, p. 19). They also open up new ways for designers to popularize their working methods in different countries, as long as local needs are taken into account and solved.

The study also showed that an action project took place, with the design of new ways for social groups to play a leading role through the use of bamboo. A design learning hub involved a structured set of learning situations, through the experiences postulated by Ranjan, Lyer and Pandya (2004, p. 1) of "seeing, discovering, thinking, building, modeling, communicating and evaluating", essential elements in building design competence. In the workshop, bamboo had significance not only as a material resource, but also as a cultural expression, allowing an integration of the knowledge of traditional Japanese peoples with the knowledge acquired at LEB and from the local community. From this perspective, the cultural dissemination of bamboo was then transmitted, as well as values associated with sustainability, through the systemic vision the participants had acquired working in the bamboo production chain experience they had.



The objectives of this project were therefore achieved, demonstrating the effectiveness of the method applied. The detailed planning made it possible to engage people in carrying out the design and executive stages, even though they had no previous experience with bamboo or the development of object design.

This initiative results' analysis process was structured into three guiding categories for discussion: the cultural and symbolic aspects, social integration and transferring of technology.

With regard to the cultural and symbolic aspects, results showed that participants' expectations regarding the workshop were based on the idea of the ancient relationship between bamboo and traditional Japanese culture. As a result, the rapprochement that took place between the participants revealed an openness to the cultural experience and a search for knowledge of new bamboo techniques by means of generational transmission. This notion of bamboo as a value gives it a place of symbolic relevance and makes it therefore cherished as a country's material culture. In other words, bamboo objects come to represent the story of the people who made them, what they are made of and how and why they were made, which, added to the variety of meanings they hold, helps to create their biography. Ingold (2010) explains this process stating that human skills are acquired by dynamic generational systems, contributing to the increase of human knowledge, which is then able to surpass the "wisdom of their predecessors" (Ingold, 2010, p. 6).

One of the festival's most striking moments was the lighting of the more than 300 bamboo lanterns at dusk, under the sound of drums. This experience was amplified for those who went through the collective production held in the workshop. This act or art form highlights the symbolic aspects engendered by the participants' aesthetic experience; in this case, the act of lighting the lanterns takes on a ritualistic and symbolic significance, that of celebrating a creative process and collective production, generating a sense of belonging to a community that has come together through work.

Ostrower (1983, p. 21) postulates that the "non-verbal character of artistic communication" allows art to be accessible simply by means of "intelligence and sensitivity", without the need for a learned understanding. In addition to that, Dewey (2010) observes that the ways in which we see and hear motivates our interest, and is an intrinsic part of the pedagogical dimension arising from personal choices and repertoires. According to Dewey, the aesthetic experience as a material is the social setting itself, "for its human quality, when in connection with the nature to which it belongs". "Aesthetic experience is a manifestation, a record and a celebration of the life of a civilization, a means of promoting its development, and also the primordial assessment of the quality of that civilization" (Dewey, 2010, p. 550).

Secondly, with regard to the social integration and technological transfer it provides, it can be said that, although bamboo lanterns played a leading role in this work's process, the social integration generated by the "conviviality" among everyone involved represented an "aesthetic of community life", since it took place more from the "quality of interaction between people" than from the social norms or objects created by designers (Koskinen, 2016, p. 24). In this way, it is understood that the quality of the social integration that took place was equally important to the final result of the work installed. As for the transferring of knowledge, which is commonly held in universities and shared with civil society, in this workshop and festival it took place in different ways, with the use of bamboo, associated with social design methods and

tools. The set of actions that took place, the relationships established between all the project participants and the method applied show that the process for the transfer of technology was carried out in a systemic way, which enabled people to experience each stage of the bamboo production chain.

As a caveat, there is a contradiction in the word transfer if considered as the codification and standardization of knowledge introduced into a different context from where it was originated, since in this case the learning process is open-ended, and the act of learning takes place in different ways, whenever the perception of a lack or gap, in a given situation, arises (Galán, 2011). We can therefore say that there are different transfer experiences running through the socialization processes.

Finally, considering the way technology and design were transferred during the workshop, it is important to point out the peculiar situation regarding communication between the Chikaken group and the participants, given the lack of knowledge of each other's languages (Japanese and Portuguese); that fact had an impact on the process of explaining the work and its intentions, clarifying doubts and conveying technical operations, considering there was a deadline for the work. However, in addition to the support offered by the japanese descendents who knew the native language, this interaction was also able to be resolved through non-verbal knowledge practices, i.e. tacit knowledge. Mareis (2012) points out that the particularities of design as a project, modeling and configuration and the act of presenting, imitating and experimenting are attributes common to tacit knowledge, the knowledges manifesting in a non-verbal way, expressing themselves through "visual, aesthetic, tactile, performative or gestural aspects" (Mareis, 2012, p. 67). These observations by Mareis (2012), anchored in Polanyi's work, show that the social dimension of knowledge is therefore a teaching-learning resource based on practice, specifically in the relationship between tacit knowledge, "expertise" and "connoisseur". The author also points out that this association ensures greater results. To do this, one relies on the "expertise" of a specialist, someone with special skills or knowledge acquired through training, study or practice, and the "connoisseur", someone whose knowledge has been acquired through extensive training, often having the competence to make critical judgments, as well as scientific measurements (MAREIS, 2012, p. 68).

## 6. CONCLUSION

Based on this case study, we can conclude that the experience of transferring knowledge took place through the process of socialization, codification and the combination of tacit and design knowledge, ending with the institutionalization of this learning, as mentioned by Galán (2011). Finally, as a result of the internalization of learning that took place, positive changes were noticed related to autonomy, as a reflection of the whole process.

The experience of the participants in the Take Akari Bamboo Lantern Workshop and Festival revealed that autonomy is an additional learning and support for the construction of knowledge, where the notion of responsibility for one's own learning motivates people to internalize and carry out new practices; it is also capable of changing beliefs, values and transforming scenarios. Exercising this autonomy encourages the maturity needed to arise, in order to face the ethical challenges needed to build a sustainability-oriented culture that offers us a system of universal values as a response to today's world.

The Take Akari Festival has given new impetus to the use of bamboo, both in the daily lives of rural communities and to their artistic expressions, and those of the urban population, due to its intrinsic qualities as a renewable, ecological and natural resource and its potential for creating products with plastic and utilitarian qualities. In this sense, the range of materials available is diverse and designers and local communities can experiment with different techniques and styles, adding the notion of sustainability to their work. Thus, in this practical experience, for all those involved, from the Japanese group promoting the initiative, to the students and staff of UNESP and the local community, bamboo was a vehicle for developing new skills and raising awareness about the environment.



## REFERENCES

CHENÉ, A. The Concept of Autonomy in Adult Education: a philosophical discussion. **Adult Education Quarterly**, v. 34, n. 1, p. 38-47, 1983.

DEWEY, J. **Arte como experiência**. 3. ed. São Paulo: Martins Fontes Editora Livraria, 2010.

DISALVO, C. et al. The collective articulation of issues as design practice. **CoDesign**, v. 7, n. 3-4, p. 185-197, 2011.

GALÁN, B. La episteme del proyecto: consideraciones sobre el conocimiento proyectual en el sistema de la ciencia y de la tecnologia. In: GALÁN, B. (Ed.). **Diseño, proyecto y desarrollo**: miradas del período 2007-2010 en Argentina y Latinoamerica. 1. ed. Buenos Aires, Argentina: Wolkowicz Editores, 2011. p. 75-102.

IKEDA, C.; MISHIRO, K. Take-Akari, Bamboo Lights, as New Japanese Culture. **Chikaken**, 2021. Available at: https://chikaken.com/english/. Accessed on: Sept. 21, 2021.

INGOLD, T. Da transmissão de representações à educação da atenção. **Revista Educação**, v. 33, n. 1, p. 6-25, 2010.

KOSKINEN, I. Agonistic, Convivial, and Conceptual Aesthetics in New Social Design. **Design Issues**, v. 32, n. 3, p. 18-29, 2016.

LEE, W. Whose Festival is it? Patterns of participation in the Japanese Matsuri. **Paragrana**, v. 22, n. 1, p. 165-179, 2013.

MAREIS, C. The Epistemology of the Unspoken: On the Concept of Tacit Knowledge in Contemporary Design Research. **Design Issues**, v. 28, n. 2, p. 61-71, 2012.



MATSUMOTO, E.; GUIOTOKO, R. T**raining new facilitators for Japan-Brazil exchange**: Bamboo, the Revitalization of a Community. São Paulo-SP: Japan Foundation of São Paulo, 2020.

MUNARI, B. **A arte como ofício**. 4. ed. Lisbon: Editorial Presença, 1993.

RANJAN, M.; LYER, N.; PANDYA, G. **Traditional wisdom**: Bamboo and cane crafts of northeast India. 1. ed. Ahmedabad, India: National Institute of Design, 2004.

SAFOUTIN, M. J. et al. A Design Attribute Framework for Course Planning and Learning Assessment. IEEE **Transactions on Education**, v. 43, n. 2, p. 188-199, 2000.

UMEKI, H. Usuki Takeyoi Festival. Oitaisan, 2017. Available at: http://oitaisan.com/english/heritage/usuki-takeyoi-festival/. Accessed on: Aug. 17. 2023.

UNITED NATIONS. Flagship UN study shows accelerating climate change on land, sea and in the atmosphere. UN, 2020. Available at: https://news.un.org/en/story/2020/03/1059061. Accessed on: Aug. 17. 2021.

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# THE ENVIRONMENTAL DIMENSION IN NEW PRODUCTS DESIGN - EDUCATIONAL TRAINING IN INDUSTRIAL DESIGN

## *A DIMENSÃO AMBIENTAL NO PROJETO DE NOVOS PRODUTOS – FORMAÇÃO EDUCACIONAL NO DESIGN INDUSTRIAL*

## *LA DIMENSIÓN MEDIOAMBIENTAL EN EL DISEÑO DE NUEVOS PRODUCTOS - FORMACIÓN EDUCATIVA EN DISEÑO INDUSTRIAL*

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**ABSTRACT**

EIndustrial design (product) was one of the most impacted professions by the changes imposed by the insertion of the environmental issue in the project. Initially contemplated in the so-called eco-design, industrial design activities underwent adjustments and improvements. These result in an expanded vision, contemplating the modern vision of sustainability, in its economic, social, and environmental dimensions. The teaching and academic applications of design in the research and extension spheres were consequently altered, demanding complementary visions throughout the process, including the PPCs of the courses and the qualification needs of the faculty. The article presents models of project processes and reflects on the need to insert sustainability issues in project teaching.

**KEYWORDS**

Product and industrial design; Design methods; Design Education

***RESUMO***

*O design industrial (produto) foi uma das profissões mais impactadas pelas modificações impostas pela inserção da questão ambiental no projeto. Inicialmente contemplada no chamado eco-design, as atividades de design industrial passaram por ajustes e aprimoramentos. Destes, resulta uma visão ampliada, contemplando a visão moderna de sustentabilidade, em suas dimensões econômica, social e ambiental. O ensino e aplicações acadêmicas do design nas esferas de pesquisa e extensão foram consequentemente alterados, demandando visões complementares em todo processo, incluindo os PPCs dos cursos e necessidades de qualificações do corpo docente. O artigo apresenta modelos de processos de projeto e faz uma reflexão para a necessidade da inserção de questões de sustentabilidade no ensino de projeto.*

***PALAVRAS-CHAVE***

*Design de produto e industrial; Métodos de design; Ensino de Design*



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## *RESUMEN*

*El diseño industrial (de productos) ha sido una de las profesiones más afectadas por los cambios impuestos por la inclusión de las cuestiones medioambientales en el diseño. Inicialmente abarcadas por el llamado ecodiseño, las actividades del diseño industrial han experimentado ajustes y mejoras. Éstas han dado lugar a una visión ampliada, que tiene en cuenta la visión moderna de la sostenibilidad en sus dimensiones económica, social y medioambiental. La enseñanza y las aplicaciones académicas del diseño en las esferas de la investigación y la extensión se han visto consecuentemente alteradas, exigiendo visiones complementarias en todo el proceso, incluyendo los PPC de los cursos y las necesidades de cualificación del profesorado. El artículo presenta modelos de procesos de diseño y reflexiona sobre la necesidad de incluir cuestiones de sostenibilidad en la enseñanza del diseño.*



## *PALABRAS CLAVE*

*Diseño industrial y de productos; Métodos de diseño; Enseñanza del diseño*




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## 1. INTRODUCTION

A project is defined as a complex activity that involves a reflective action of thought (abstract), a creative dimension, and the materialization of the result (concrete), requiring multidisciplinary knowledge to equate all the factors involved in the creation of a product/artifact that aims to meet the needs of users. Starting from the question that there are still conceptual conflicts, in this article, project will be treated as synonymous with design, and product will be addressed broadly, as defined by Kotler and Armstrong (2015), who state that a product is something that can be offered to a market to satisfy a need or desire, and that it can be tangible or intangible, for organizations or consumers.

Although this broader definition is used in the field of administration and business, in the intention of discussion proposed here it is more appropriate, according to the objectives outlined, encompassing sustainability as a guiding factor.

In the 1970s, Papanek (1977) was the precursor who questioned the profession of designer in the way he presented himself and already demanded an environmental, moral, and social responsibility on the part of this professional. He argued that in an era of mass production, design had become a powerful tool in the configuration of man's tools and environments and emphasized the importance of understanding the basic needs of human beings and their relationship with design.

The author also stated that it was necessary to design within a social context. Its role was to demand greater engagement from designers and, above all, the creation of a design to meet social needs.

Thackara also points out design and its alternatives for a complex world. The author points out that currently many designers are already designing services and systems that are visibly less harmful to the environment and more socially responsible, but emphasizes the need for change, proposing a paradigm shift: 'In this new era of collaborative innovation, designers are having to evolve from individual authors of objects to facilitators of change among large groups of people' (THACKARA, 2008, p. 21).

Thus, it is observed that design for sustainability must be carried out collaboratively and must seek to work under the three levels of sustainable development: be economic, not harmful to the environment, and accessible to all. As already highlighted, much has already been done on this aspect, but it is necessary to consider that we still live in an economy of consumer politics, in a world with enormous social inequalities. With this, the power that design exerts over people can be considered both surprising and shrewd, making us accomplices of this accentuated consumerism.

Manzini and Vezzoli (2008) include the precepts of sustainability in design when they stated that product design should be understood according to its broad and current meaning, not applying only to the physical product (defined by material, form, and function), but extending to the system – product, that is, to the integrated set of product, service, and communication. Within this line of thought, the authors highlighted that the project is the activity that should "link" the technically possible with the ecologically necessary acting within four levels of interference: environmental redesign of existing products; design of new products to replace current ones; design of new products – intrinsically sustainable services; and proposal of new scenarios for a new sustainable lifestyle.

Santos and others (2018) show that even with the conceptual evolution of the period from 2008 to 2018 (date of the two publications mentioned), the professional performance of people related to the project areas still occurs, in most cases, in the first two levels. Although this was relevant to the maturation of the theme in the area, nowadays, it is insufficient to achieve environmental sustainability, guaranteed only by the other two levels (Design for Sustainability). Therefore, there is still a need for behavioral change in the project activity, focusing on paradigm shifts every time a new product is designed.

In this case, the project encompassing the precepts of sustainability becomes the most relevant possible solution for the union between the philosophy of continuous improvement (kaizen) with the increasing need to preserve natural resources, human quality of life, and current capitalism. The understanding of this was so impactful that the UN established, in 2015, the 17 Sustainable Development Goals (SDGs), with measurable effectiveness plans for the year 2030, wherein a reinterpretation of the principles of total quality, something like a PDCA (Plan, Do, Check and Action) will be rotated on each of the SDGs (and its 169 goals).

This article aims to study the evolution of environmental issues in the design process of product and industrial design based on design methodologies traditionally used in undergraduate courses in Product Design and Industrial Design.

## 2. BACKGROUND /CONCEPTUAL DISCUSSION

The design has undergone many modifications in its design form over the years. As projects become more complex and with several factors to be met, the design processes have also been improved, with the inclusion of new requirements and new concepts. The extremely sequential view of the first methods falls heavily on the very classical definition of the word project, from the Aurélio Dictionary online, and originated from the Latin project, which means "launched ahead" and denotes the "idea that is formed to execute or accomplish something in the future; plan, intent, design".

The study of design methods has become increasingly detailed in design, such as Löback's definition of design (2001, p. 16): "[...] an idea, a project or a plan for the solution of a given problem". The author presents its basis for the configuration of industrial products, and addresses aspects such as categories of industrial products, product functions (practical, aesthetic, and symbolic), and describes the design process in four main phases: problem analysis, generation of alternatives, evaluation of alternatives and solution of the problem.

Munari (1998) is another example of a sequential method widely used in design from the 1990s to 2000s. It presents the advantages of being suitable for beginners and to have a language that is easy to understand. However, it is considered a superficial method and does not conveniently address market, management, ergonomics, strategy, and environmental issues. Figure 1 illustrates the design method of Munari (1998)

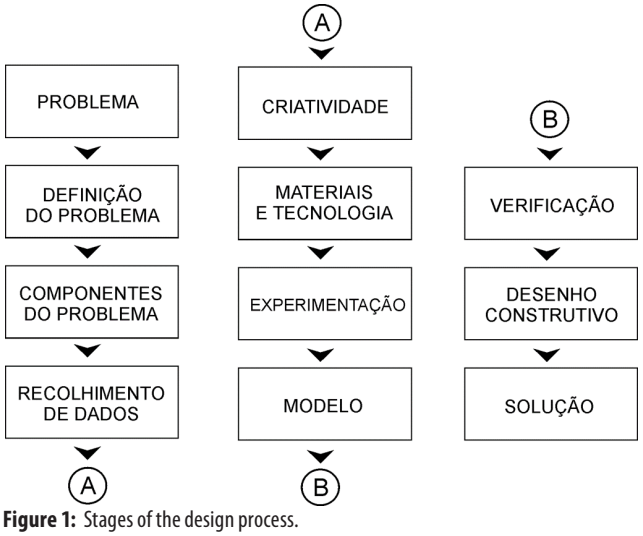


**Figure 1:** Stages of the design process.
**Source:** Munari (1998).

When studying the design methods used in the early 2000s in undergraduate design courses, it is noted that in addition to Löbach, several other authors were used. The design process was considered "closed", with the designers initiating a stage only after the completion of the previous stage.

Strunk (2001, p. 15) when referring to the activity of a designer states: "[...] our language is rich, but unfortunately there is no word that translates exactly what we do. Our mission is related to the conception, to the creation of concepts that, once formalized, can make information circulate as effectively as possible, and this without giving up the aesthetic pleasure that is proper to human beings".

Baxter (2000) – another well-known author, stated that the development activities of a new product require research, careful planning, meticulous control, and the use of systematic methods, requiring an interdisciplinary approach (marketing activities, product and process engineering, application of knowledge about aesthetics and style, etc.). Figure 2 illustrates the methodological procedures for the development of Baxter's products (2000).

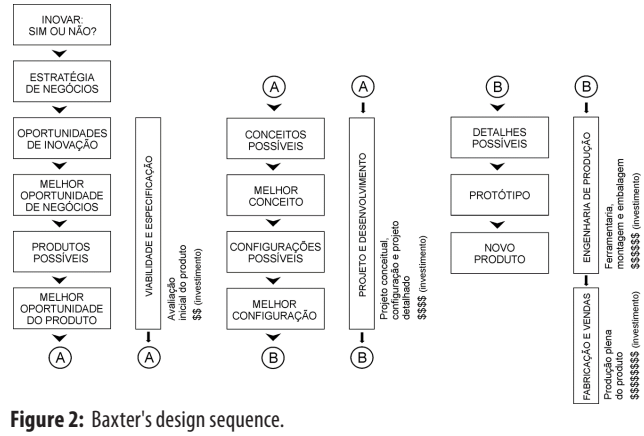


**Figure 2:** Baxter's design sequence.
**Source:** Baxter (2000).

It is observed that both also did not address, even superficially, the environmental issue in product development. The concept of conceptual design was widely used in the 1990s-2000s in design schools. It was created by Pahl and Beitz, and through the translation of Baxter's book by Itiro Iida, it came to govern the entire study of project methods in design.

As a broadly interdisciplinary activity, project methods have become the subject of research in fields other than design. Product engineering and production areas have also developed project methods but are still working in a Cartesian way. Two of these methods that can be mentioned here are those developed by Back et al. (2008) and Rosenfeld et al. (2006).

In the case proposed by Back (1983), there are the "phases of the design of industrial products". From this point,

it was already clear that some methods focus more on a given point, others on another; however, with a greater or lesser degree of depth, all encompassed: feasibility study, preliminary design, detailed design, review and testing, production planning, market planning, planning for consumption and maintenance and obsolescence planning. In this last item, some points began to appear very timidly concerning eco-design, very concentrated still only on the issue of component reduction and recycling.

However, although the detailing steps provided very precise technical identifications, there was no step (for instance) that led the designer (or project team) to establish correlations between the environmental, economic, ergonomic, market, manufacturing, and aesthetic variables; in addition to the aforementioned problem of being sequential, inducing non-return to previous steps.

Santos (2005) began the process of transitioning to what is known as the open project method. He concluded, based on applied studies with classes of industrial design students, that the project methods commonly used in design education did not adequately meet the National Curriculum Guidelines. This happened, according to the author, because they did not stimulate the development of certain skills and competencies that a professional in this area should present.

Thus, Santos (2005) proposed the MD3E – 3-Step Deployment Method, where the design problem is being treated radially. In this type of deployment, it is no longer necessary for one stage to end to start another, and the design process becomes more inclusive, interdisciplinary, and fast. Figure 3 shows MD3E in its original form (on the left) and in its application form via software (on the right).

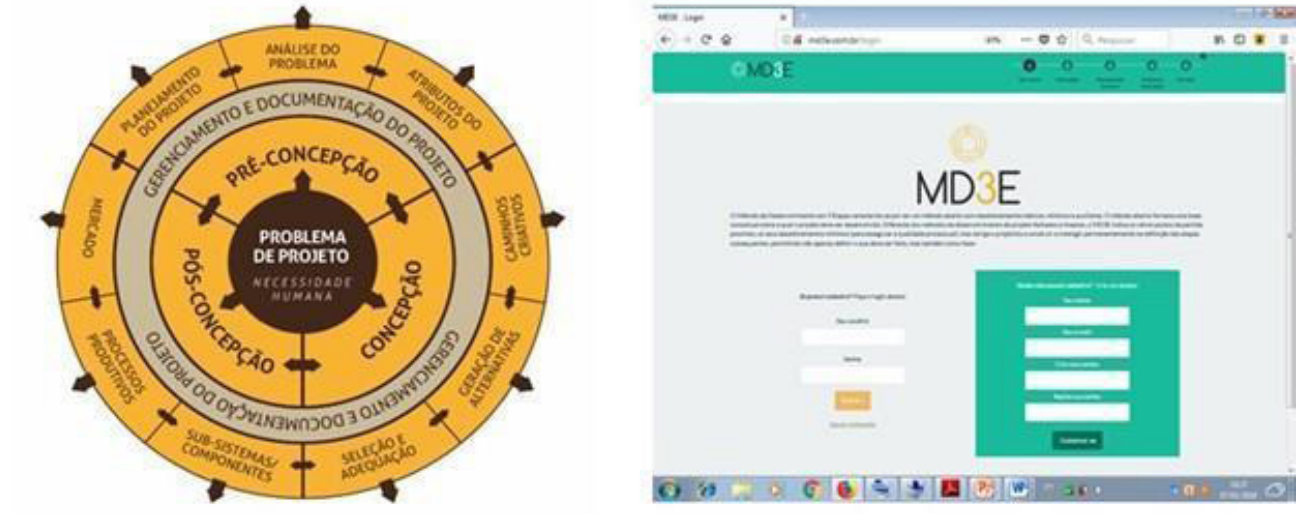


**Figure 3:** 3-Step Deployment Method.
**Source:** Santos (2005 and 2017).

In summary, the method of Santos (2017) allows greater freedom for the project team, while other methods, such as those mentioned above, have a more traditional and systematic structure. Due to the current curricular structure of design courses, the choice of an "open" or "semi-open" method allows material choices, for example, to be made in several stages, and the issue of sustainability is linked to materials. Ferroli and Librelotto (2023) use these concepts to show that materials in a design process involve two steps: Choice and Selection of Materials. This does not happen in closed methods, often leading to erroneous choices.

The design student must understand that the project encompassing the precepts of sustainability is the solution to combine continuous improvement with the increasing need to preserve natural resources, human quality of life, and current capitalism. This goes beyond the internal classroom activity.

In 2005, after a case study of the design process in eleven large companies such as Alessi, Sony, and Xerox, among others. The Design Council concluded that designers' processes have common similarities and approaches. Thus, they propose a simple four-step diagram called the double diamond model or double diamond, as shown in Figure 4.

In 2008, in the Harvard Business Review, Tim Brown of IDEO presented the term "design thinking" not as a project process but as a thinking attitude towards innovation.

The design thinking process has three phases: 1. Inspiration, where a problem or a need is analyzed by observing extreme target audiences (children, adults) identifying an opportunity, the data collected is synthesized

through insights, tell stories; 2. Ideation, which has stages of creativity, production of drawings, models, and tests. At this stage, the author recommends internal communication between the team; 3. Implementation, which covers the production and placing on the market of the product or service. Figure 5 shows the design thinking scheme that has become widely disseminated in several bibliographies.

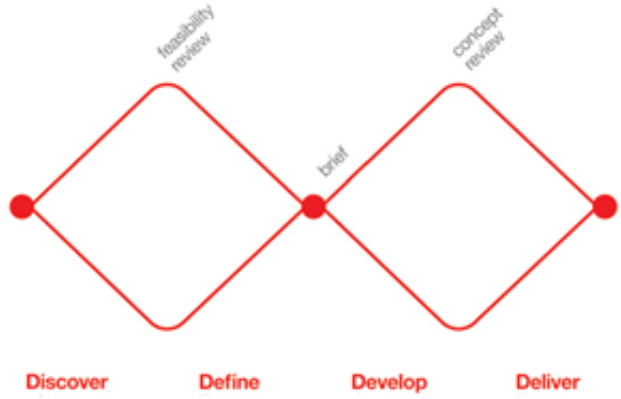


**Figure 4:** Double Diamond Model.
**Source:** Adapted from Design Council 2005.

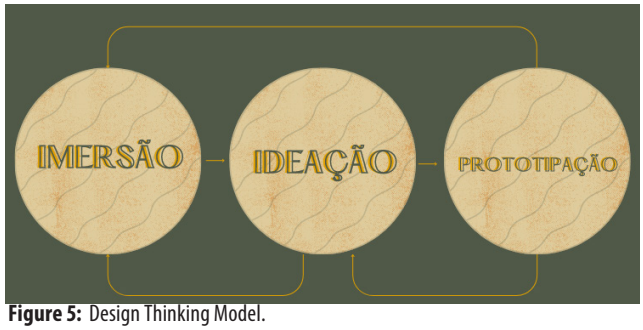


**Figure 5:** Design Thinking Model.
**Source:** Adapted from Brown (2008).

Pazmino (2013) presents a mixed project structure relating to a cyclical process planning, informational design, conceptual design, preliminary design, and detailed design, as illustrated in Figure 6.

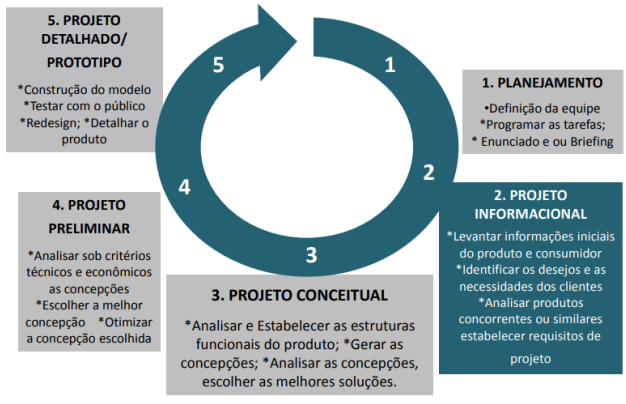


**Figure 6:** Mixed Project Structure.
**Source:** Pazmino (2013).

According to Pazmino (2013), the environmental issue is addressed in this proposal in the definition of project requirements, that is, in the informational or immersion project. This detail shows the main difference between traditional and new (open) methods. Both Santos (2017) and Pazmino (2013) provided the inclusion of environmental issues more clearly, taking as a precursor what was proposed by Rosenfeld and others (2016), specifically in what the authors called PDP - Product Development Process. As can be seen in Figure 7, it can be noted that the system is sequential, but unlike the closed methods, it allows a return to the previous steps to correct or modify decisions previously made.

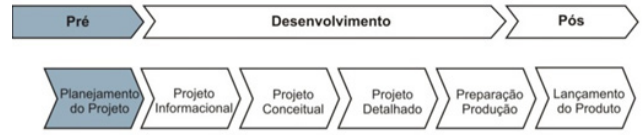


**Figure 7:** PDP - Product Development Process.
**Source:** Adapted from Rosenfeld et al (2006).

Figure 8 better explains this moment of transition. Part A shows the PDCA cycle, a tool commonly used in the 1980s in the industrial/manufacturing context to meet the growth of interest in the search for total quality, which served as a conceptual basis to demonstrate the need to become more "open" to project methods. Rosenfeld et al. (2006) explain this throughout the details of the phases that follow: informational design, conceptual design, detailed design, production preparation, and product launch, explaining, as can be seen in part B of the figure, that as the degree of uncertainty decreases, and consequently also causes a reduction in the number of choices, on the other hand, there is a large increase in the cost part, as time passes. Evidently, the exchange of materials and all the change that comes with it (machines, manufacturing processes, molds, productivity, etc.) is the crux of this problem.

Seraphim et al. (2019) deliver a study presenting the BIOS method, a tool for developing sustainable biomimetic products. With the natural union of Design with Biology, working in an integrated approach to the Product Development Process, the authors concluded that the application of the tool and the technological innovations resulting from this application may contribute to the reduction of negative impacts on the environment when compared to similar products on the market.

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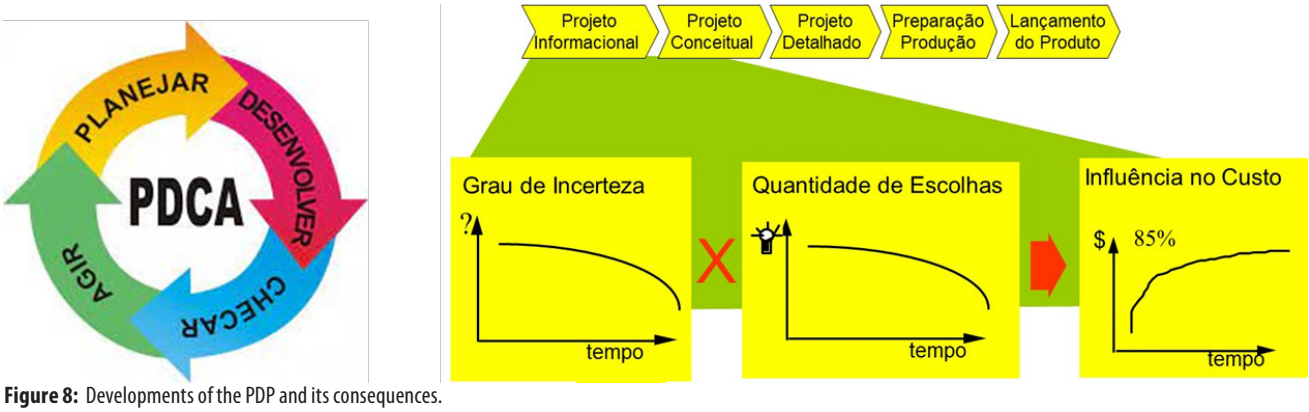


**Figure 8:** Developments of the PDP and its consequences.
**Source:** Adapted from Rosenfeld et al (2006).

When relating the proposal to that proposed by Rozenfeld et al. (2006), the structure is presented as shown in Figure 9. The proposed method can apply the biomimetic concepts to the Integrated Product Development Process (IPDP) and, according to the authors, it allowed to achieve promising results within the precepts of sustainability, assisting Engineering and Design professionals in the generation of ideas through the concepts of Biomimetics, contributing to the development of environmentally friendly products. In this way, the BIOS can serve as an easy guidance tool for generating viable solutions and alternatives, enabling the understanding of the universe of biomimicry and its paths to bioinspiration.

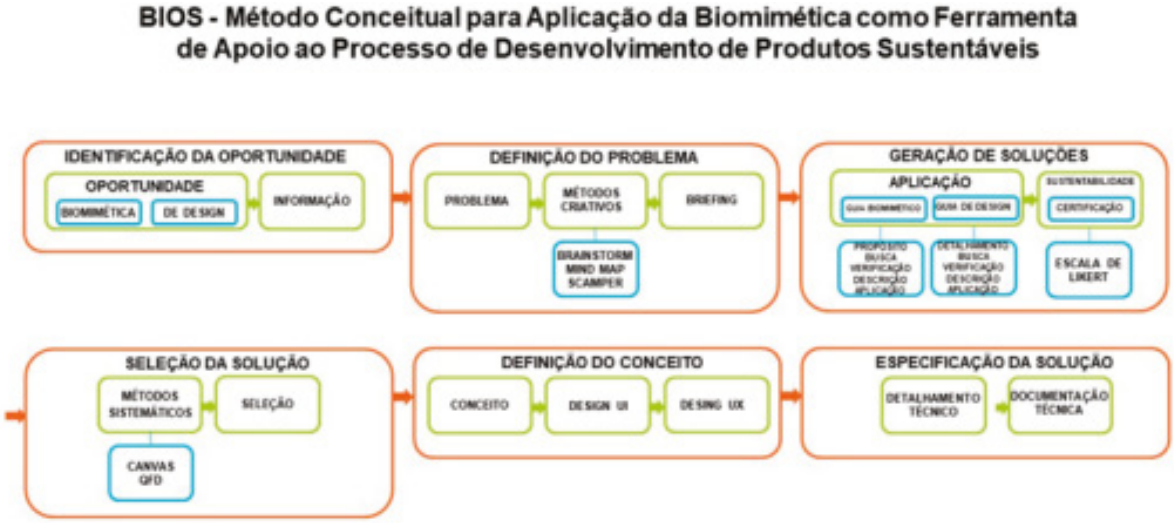


**Figure 9:** Developments of the PDP and its consequences.
**Source:** Adapted from Rosenfeld et al (2006).

The methods presented show the variety of design processes used in the teaching and practice of product design development. Environmental and social concern could be inserted in any of them. For this, as mentioned by Pazmino and Santos (2017) in design courses, it is necessary that the cross-cutting theme of sustainability integrates content from the course subjects, allowing the student to develop a broad view of the relationship between environment, user, and product and a holistic view of current problems that affect society, sensitizing them to the most relevant issues regarding ethical and socio-environmental responsibility in the development of their professional activities. It will also allow one to form a code of conduct to be a critical, active, and reflective citizen on topics regarding different dimensions of sustainability.

In the project subjects, it is up to the teacher to direct related themes and throughout the project to apply environmental guidelines that consider the life cycle so that the subjects of the curriculum matrix can insert into their contents the low-impact materials, the references of bionics and biomimicry. Adapt project models to social and environmental approach.

Balbio et al. (2019) associate biomimicry with initiatives to reduce or even replace the consumption of petroleum-derived plastics in various industrial segments, especially with the incorporation of biopolymers (bioplastics),

which, unlike synthetic polymers, derived from petrochemical hydrocarbons, are generated from renewable raw materials.

Despite the significant advances in recent years, and their increasing connection with design, specifically with studies focused on biomimicry, biopolymers still have certain considerations regarding their use, which require studies. Among these, we can emphasize the use of certain foods (potatoes and corn mainly) and the cost that this implies, even using the soil for generating raw materials. These two factors combined create resistance in the food (supply) sector and concern about food generation for an increasing population. There is also some technological resistance to the transformation of these materials.

## 3. CONCLUSION

Reflections on the relationship between design action and project processes, as well as sustainability issues, should be present in design education from the early stages and permeate the curriculum of the courses, as well as for more open, flexible processes to be used in design disciplines, allowing the insertion of environmental and social criteria.

Throughout the history of designing and industrial design, the concern has been to reduce costs, maximize profits, and improve quality. However, both the increase in products as well as the projected and perceived obsolescence have created an amount of polymer, electronic, non-recyclable waste that has given its name to this era of Anthropocene.

It is necessary to question and insert knowledge in the training of future designers so that they are responsible and creators of appropriate solutions for society and the environment.



## REFERENCES

BACK, Nelson; OGLIARI, André; DIAS, Acires; SILVA, Jonny Carlos da. **Projeto Integrado de Produtos** – Planejamento, concepção e modelagem. Barueri (SP): Manole, 2008

BAXTER, Mike R. **Projeto de Produtos**: guia prático para o design de novos produtos. São Paulo: Blucher, 2000.

BROWN, Tim. **Design thinking** in Harvard business review. p. 84-91. June 2008.

DESIGN COUNCIL UK. The **Design Process**. 2005 <http://www.designcouncil.org.uk/about- design/How-designers-work/The-design-process/%3E.

FERROLI, Paulo Cesar Machado; LIBRELOTTO, Lisiane Ilha. **Materiais em Quadrinhos**. Florianópolis: Virtuhab, 2022

KOTLER, P.; ARMSTRONG, G. **Princípios de marketing**. 15 ed. São Paulo: Pearson Prentice Hall, 2015.

LAGO, André Aranha Corrêa do. **Conferências de desenvolvimento sustentável**. André Aranha Corrêa do Lago. – Brasília : FUNAG, 2013.

LIBRELOTTO, Lisiane Ilha; FERROLI, Paulo Cesar Machado; DOEHL, Yasmin Curvelo; PRADA, Julia Cipriani; DIAS, Pablo Henrique Laguna. Ações de desenvolvimento educacional para pesquisa, ensino e extensão em materiais e processos. **ENSUS 2023 - XI Encontro de Sustentabilidade em Projeto (anais)**.Florianópolis, Virtuhab, p. 195-205.

LOBACH, Bernd. **Design industrial** – bases para a configuração dos produtos industriais. São Paulo: Blucher, 2001.

MANZINI, Ezio e VEZZOLI, Carlo. **O Desenvolvimento de Produtos Sustentáveis** – Os requisitos ambientais dos produtos industriais. São Paulo: EdUSP, 2008.

MUNARI, Bruno. **Design e Comunicação visual**. São Paulo: Martins fontes, 1998.

PAPANEK, V. **Design para el mundo real**: Ecologia humana e cambio social. Madrid: Ediciones Blume, 1977

PAZMINO, Ana Veronica. **Como se cria**: 40 métodos de design de produtos. Ed. Blucher. São Paulo, 2015.

PAZMINO, Ana Veronica; SANTOS, Shibata Adriane. **Design e Sustentabilidade**: Necessidade de Quebra de Paradigma no Ensino. In: Revista Mix sustentável. V3. N.1/2017.

ROZENFELD, Henrique; FORCELLINI, Fernando Antônio; AMARAL, Daniel Capaldo; TOLEDO, José Carlos de; SILVA, Sergio Luis da; ALLIPRANDINI, Dário Henrique; SCALICE, Régis Kovacs. **Gestão de Desenvolvimento de Produtos**

– Uma referência para a melhoria do processo. São Paulo: Saraiva, 2006

SANTOS, Aguinaldo; LOPES, Camila S. D.; SAMPAIO, Cláudio P. de; TREIN, Fabiano A.; CHAVES, Liliane I.; LIBRELOTTO, Lisiane Ilha; FERROLI, Paulo Cesar Machado; LEPRE, Priscila R.; ENGLER, Rita C.; MARTINS, Suzana B.; NUNES, Viviane G. A. **Design para a sustentabilidade**: Dimensão Ambiental. Curitiba: Insight, 2018.

SANTOS, Flávio Anthero Nunes Viana dos. **Método de Desdobramento de Três Etapas**. http://md3e.com.br. 2017. <Acesso em setembro de 2021>

STRUNK, Gilberto. **Viver de Design**. Rio de Janeiro: 2AB Editora, 2001.

SERAPHIM, Francisco; SALDANHA, João Alberto; FERRARI, Roberta; CANCIGLIERI, Osiris. **Uma análise sobre a aplicação de uma ferramenta de apoio ao processo de desenvolvimento de produtos biomiméticos e sustentáveis.** In: ARRUDA, Amilton J. V., ROBERTO, Antônio. LIBRELOTTO, Lisiane Ilha, FERROLI, Paulo Cesar M., SOARES, Theska. Tópicos em Design: biomimética, sustentabilidade e novos materiais. Curitiba: Insignt, 2019.

THACKARA, J. **Plano B**: o design e as alternativas viáveis em um mundo complexo. São Paulo: Saraiva: Versar, 2008.

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LIL: conceituação, análise formal, aquisição de financiamento, investigação, metodologia, administração de projetos, visualização, escrita - rascunho original, escrita - revisão & edição.

AVP: conceituação, análise formal, investigação, metodologia, escrita- revisão & edição.

LLOP: escrita - revisão & edição.

**Conflict declaration:** nothing has been declared.

# DESIGN SCENARIOS AND ECOTOPIAS. NOTES FOR THE DEVELOPMENT OF A SOCIO-ENVIRONMENTAL DESIGN LABORATORY

## *CENÁRIOS PROJETUAIS E ECOTOPIAS. NOTAS PARA O DESENVOLVIMENTO DE UM LABORATÓRIO DE DESIGN SOCIOAMBIENTAL*

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### ABSTRACT

This paper presents the conceptual underpinnings organized by a group of designers and design researchers for the creation of the Ecotopias Socioenvironmental Design Laboratory at PUC-Rio University. It begins by discussing the anthropogenic crisis, which the planet is currently facing, and the consequent design crisis. It also presents the field of design for sustainability, its transversality and eco-logic possibilities. It situates the process of constructing scenarios in this field as a methodological option for opening the imaginative and anticipatory potential of art and design to confront the planetary environmental crises and regenerate ecologies of the mind, social relations, and the environment. It describes the methodological steps of the scenario-building process derived from the project Sustainable Everyday, and, finally, it distinguishes the concepts of utopia and ecotopia.

### KEYWORDS

Crisis; Design for sustainability; Ecology; Scenarios; Ecotopias.

### RESUMEN

Este artículo tiene como objetivo presentar las bases proyectuales organizadas por un grupo de diseñadores e investigadores en diseño, para la constitución del laboratorio de diseño socioambiental Ecotopías, alojado en la PUC-Rio. Como punto de partida, se aborda la crisis planetaria de origen antrópico y la consiguiente crisis proyectual. Se introduce el campo del diseño para la sostenibilidad, su transversalidad y las posibles eco-lógicas. Se ubica el proceso de construcción de escenarios en este campo como opción metodológica para poner a disposición el potencial imaginativo y anticipatorio del diseño y las artes, frente a la crisis planetaria y la regeneración de las ecologías de la mente, las relaciones sociales y el medio ambiente. Se describen los movimientos metodológicos del proceso de construcción de escenarios, basándose en la experiencia de investigación y proyecto Sustainable Everyday, llegando a distinguir los conceptos de utopía y ecotopía.

### *PALABRAS CLAVE*

Crise; Diseño para la sostenibilidad; Ecología; Escenarios; Ecotopías



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***RESUMO***

Este artigo tem o objetivo de apresentar as bases projetuais organizadas por um grupo de *designers* e pesquisadores em design, para a constituição do laboratório de *design* socioambiental Ecotopias, hospedado na PUC-Rio. Como ponto de partida, discute a crise planetária, de origem antrópica, e a consequente crise projetual. Apresenta o campo do *design* para a sustentabilidade, sua transversalidade e eco-lógicas possíveis. Situa o processo de construção de cenários nesse campo, como opção metodológica para disponibilizar o potencial imaginativo e antecipatório do *design* e das artes, no enfrentamento da crise planetária e na regeneração das ecologias da mente, das relações sociais e do meio ambiente. Descreve os movimentos metodológicos do processo de construção de cenários, a partir da experiência de pesquisa e projeto *Sustainable Everyday*, chegando a distinguir os conceitos de utopia e ecotopia.

***PALAVRAS-CHAVE***

Educação, pesquisa e extensão, Amazônia, educação universitária.

## 1. PLANETARY CRISIS

Climate change and various ecological imbalances are transforming the Earth's geography and threatening its vitality. July 3rd, 2023, was the hottest day in the hottest month in the hottest year in recorded history, and the Copernicus Climate Change Service forecast that the next years will inevitably be worse (Copernicus, 2023). Among the most violent effects of this growing heat, there is a disturbing succession of extreme and exceptional meteorological phenomena, such as El Niño, which originates in the South Pacific and extend its impacts to Brazil. The tropical cyclone Catarina in the southern Atlantic was the first recorded hurricane-force storm in this region (Brazilian Meteorological Society, SBMET, 2005), and inaugurated a rapid succession of similar events, besides the related floods. The year 2023 was marked by several such events that tragically caused the deaths of many dozens of people, here remembered with profound sorrow. While this was happening in the south and southeast of Brazil, the country´s north and even the Amazon rainforest were affected, though in this case with an ongoing catastrophic drought.

Considering other recent emergencies, such as the pandemic or the wars that are multiplying across the planet and revealing the illusory promise of the United Nations, humanity is suffering a crisis that is probably unique in its complexity, severity, global extent, and possibly duration.

. Societies and communities can offer little relief. On the contrary, job insecurity, poverty, and inequality are growing. Driven by social networks, the many ideological, ethnic-racial, and religious conflicts are increasing, and include even rifts between genders and generations.

Stress and exhaustion, anxiety and anguish, depression and other disorders are on the rise, and include younger and younger populations (World Health Organization, WHO, 2021). Family members and educators face these new challenges without the proper preparation.

. These developments are a sign of the crisis affecting the three ecologies identified by Félix Guattari (2011), not only the environmental and social ones, with which design has experience, but also the ecology of the mind (see also Bateson, 1980), that is, the ecology of human subjectivity.

Spirituality comes to assist by reestablishing the connection between the ecologies. As a way of understanding the world and our existential yearning, spirituality can aid in the production of individual and collective subjectivities, fostering awareness of their interexistence and their ecological relationship with the cosmos (Gebara, 1997; Boff, 1999; Hanh, 2009). Even in the West, where secularization advanced together with industrialization, today the call for ecological conversion resonates (Francisco, 2015).

## 2. DESIGN CRISIS AND INPUTS FOR A REGENERATION OF DESIGN

For some time now, design has been searching for new paradigms of thought and action in confronting the most harmful effects of industrialization, that is, effects that design itself has contributed to causing. Designers have long recognized the need to reevaluate their responsibilities and true potential, and to develop alternative ways of operating (Maldonado, 1970; Papanek, 1971; Buckminster Fuller; Applewhite, 1975; 1979; Manzini, 1990; Manzini; Jégou, 2003; Thackara, 2005; Bistagnino, 2009; Fry, 2009; 2020; Fletcher, 2010; Mang, Reed, 2012; Fuad-Luke, 2013; Ellen McArthur Foundation, 2013; Irwin, 2015; Escobar, 2018; Fry, Nocek, 2020; Wahl, 2020).

Faced with the crisis described above, however, fear seems to be prevailing. As predicted (Heidegger, 2007), The Promethean myth faltered (Anders, 2002; Galimberti, 1999; Latour, 2014) and the optimism normally associated with technical progress (Simondon, 1989) is giving way to pessimism, skepticism, and cynicism (Jonas, 2006; Engelhardt, 1996). How to design today?

The distrust is such that part of the design community discredits its methods and results, as well as its potential, so that concepts such as design and even future can become taboo. There is a perceived need to seek knowledge and creative practices in other fields of knowledge, which, in this way, hybridize with design and may eventually become integrated into the faltering myth.

The XXII Triennale di Milano was a response to design and planetary crises. For this 2019 edition of the event, Paola Antonelli organized the exhibition Broken Nature, unique for its sensitivity and the design intelligence of the displayed works (http://www.brokennature.org/). Among these were Wheatfield – A confrontation, by Agnes Denes, honored with the imagistic epigraph (figure 1).

**Figure 01:** Agnes Denes, Wheatfield - A Confrontation, Battery Park Landfill, New York, 1982. **Source:** http://www.agnesdenesstudio.com/works7-WFStatue.html

Antonelli and the other exhibition's co-curators identified and articulated five thematic sections (Antonelli; Tannir, 2019, p. 5-9, authors' translation):

- A Change Climate, which provided scientific demonstrations of the phenomenon, expressed with a graphic language of high aesthetic value;
- Complex Environments, which explored the complexity of socioenvironmental ecosystems;
- Made and Unmade, which presented practices and experiments based on the principle of circularity that characterizes ecosystems in dynamic balance;
- Mores of the Times, which illustrated the transformative potential that resides in the daily lives of individuals and communities;
- Bridges, which explained the necessary relationships of mutuality between humans and all beings that inhabit the biosphere, highlighting their interdependence.

The first two sections, A Change Climate and Complex Environments, explored the visual and non-visual sensitivities elaborated by design and art to explore, perceive, and understand socioenvironmental phenomena and their ecosystemic complexity. The potential of these are increasingly valued by design culture, whether in terms of quantity, as with many infographics, or in terms of quality, as with many conceptual and speculative design projects (figure 2).

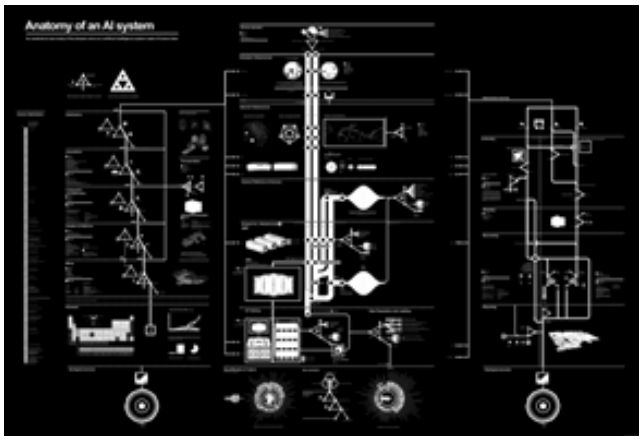


**Figure 02:** Kate Crawford and Vladan Joler Anatomy of an AI System, 2018. The infographics depicts the Amazon Echo as an anatomical map of human labor, data and planetary resources. **Source:** https://anatomyof.ai/

The remaining three sections present some of the paths that design culture is taking to develop alternatives, with projects that are developed from perspectives and rationalities alternative to those practiced by industrial design, and that result in alternative propositions to existing solutions (figure 3).

**Figure 03:** Sanjeev Shankar, Living root bridges, 2020. Living root bridges are Ficus-based ecosystems within dense subtropical moist broad-leaf forest ecoregion of Meghalaya in North--Eastern Indian Himalayas. **Source:** http://www.sanjeevshankar.com/living-root-bridges.html and http://www.livingrootbridges.org/

The proposals collected in Made and Unmade explore circularity in opposition to the linearity that characterizes the industrial chains of production, distribution, consumption, and disposal. Furthermore, the proposals collected in Mores of the Times explore alternatives inspired by people's daily lives, frequently prepared without the involvement of design professionals. Finally, the proposals collected in Bridges explore the importance of the relational dimension in design projects, valuing solidarity between people in a time of strong intra- and inter-cultural divisions, and the necessary mutuality between all living beings.

This way, according to Paola Antonelli, the XXII Triennale di Milano:

> describes the concept of restorative design and studies the state of the threads that connect humans to their environments (economic, social, cultural, political) and to those of other species

> (animals, plants, microbes – the whole tree of life, as well as species yet unknown), at all scales and in all systems (Antonelli, 2019, p. 21, authors' translation).

The concept of restoration can be associated with that of regeneration, which is gaining space in design discourse (Mang, Reed, 2012; Wahl, 2020; Gárcia, Freire, Franzato, 2024), and which affirms in an even more decisive way that design culture can retrospectively examine ecologies and then strive forward by restoring lost ecological relationships and caring for them.

The exhibition offered messages of warning and hope for society, which profoundly resonated with visitors thanks to the intelligence and beauty of the works on display. Specifically for the field of design, the exhibition offered relevant input for a productive regeneration of design for sustainability, if not design as a whole.

## 3. THE FIELD OF DESIGN FOR SUSTAINABILITY

The design field is traditionally subdivided into disciplines identified by the specific aspects of their results or by their productive sectors, such as product, fashion, interior and graphic design, just to mention the main designations identified by the Brazilian Education Ministry (Brasil, 2023), and we can continue with service design, digital design, etc.

The turn of the millennium corresponds to a methodological turn in the design field. Particularly since the 1990s, transversal design approaches have begun to appear which are characterized by the processes that support, articulate, and drive the most diverse design projects, and which contribute to qualifying them.

Among these approaches, design for sustainability has undergone a particularly relevant evolution, presented in figure 4 by Fabrizio Ceschin and Idil Gaziulusoy (2016. See also Franzato, 2022). In this diagram, the technology-people vertical axis proceeds from a design aimed at developing technological innovation, towards one aimed at socio-technical innovations. The insular-systemic horizontal axis proceeds from a design aimed at addressing specific innovations, towards

a design aimed at changes in broader systems, becoming increasingly strategic (Ceschin, Gaziulusoy, 2016, p. 141). Below the diagram is the timeline of this design evolution.

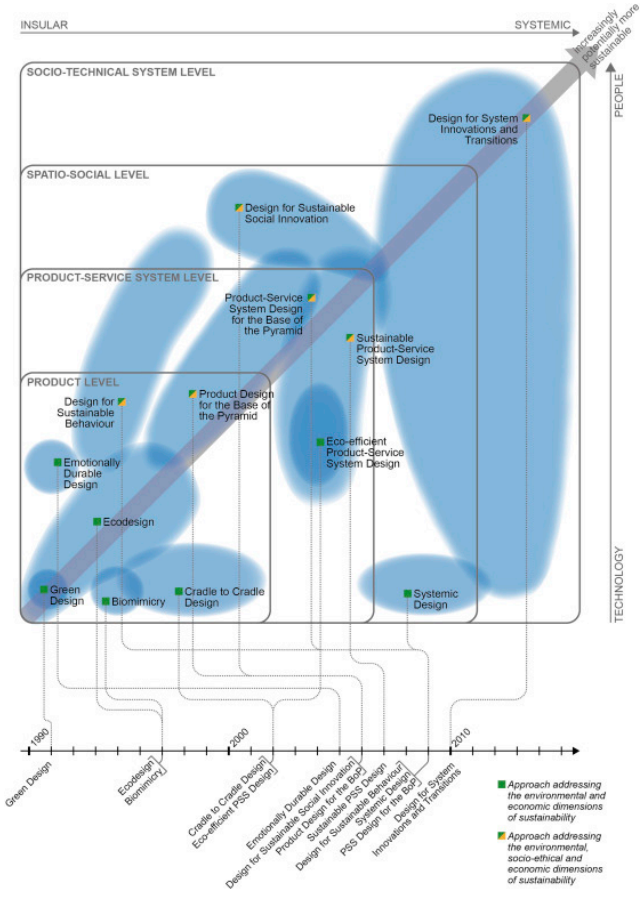


**Figure 04**: Diagram of the evolution of design for sustainability and its relative timeline. Source: Ceschin; Gaziulusoy, 2016, p. 144. Please, find a link to a higher resolution image here: https://ars.els-cdn.com/content/image/1-s2.0-S0142694X16300631-gr2.jpg

At the starting point of this trajectory, design was concentrated on technical product development, where the authors identify the approaches of Green Design, Ecodesign, Biomimicry, Cradle-to-Cradle Design, Emotionally Durable Design, Design for Sustainable Behavior, and the Product Design for the Base of the Pyramid. Gradually, design moved to a second level of Product-Service Systems development, with the approaches for designing Eco-Efficient, Sustainable, or Base of the Pyramid Product-Service Systems. Then, it moved to a third spatio-social design level, with the approaches of Systemic Design and Design for Sustainable Social Innovation. Finally, design reached a fourth level focusing on socio-technical systems, with Design Systemic Innovation and Transitions.

The diagram´s trajectory also describes the transition from an understanding of sustainability linked to the impact of human development on the environment, to an increasingly conscious understanding of the integrated nature of sustainability. Today, it has become erroneous to consider only one or a few dimensions of the impact of development, and the biggest mistake would be to ignore the environmental impact in particular.

The trajectory also denotes a maturation of the design discourse for sustainability from an ecological perspective. In this direction, the diagram could consider the ecological complexity addressed by Guattari (2011), giving space, not only to environmental ecology and social ecology, with which design has clear experience, but also to the ecology of the mind. This is a point of attention for the design for sustainability community, as it opens the possibility of a new chapter in the evolving discourse. It opens up to a fully ecological design, for which sustainability is not merely a technical challenge, not even a socio-technical one, but originally an ecosophical challenge to be faced "under the ethico-aesthetic aegis of an ecosophy: social ecology, mental ecology and environmental ecology" (Guattari, 2000, p. 41).

The community noted above is broad and diverse and, in Brazil, is connected through the Mix Sustentável journal and various events, such as the Project Sustainability Meeting (Encontro de Sustentabilidade em Projeto, ENSUS), the Bionics and Biomimetics Forum (Fórum de Biônica e Biomimética), and the Symposium on Sustainable Design (Simpósio de Design Sustentável, SDS). Important international research networks also operate across the country, such as the Learning Network on Sustainability (LeNS) and the Design for Social Innovation and Sustainability (DESIS) network.



Due to its transversality, design for sustainability crosses disciplines and can extrapolate from the design field while interacting with others, such as administration or communication. Given design's origins, design for sustainability can also interact with arts and crafts. Clearly, it interacts with artisanal craft, with which it has always maintained a very lively dialogue. Furthermore, many believe that it should interact much more with the arts as well as with the humanities, especially if sustainability is considered as a socio-technical, ethico-aesthetic, and ecosophical challenge.

The importance of the ecological issue and the urgency of the many crises we face demand the convergence and collaboration of all disciplines, as well as other contributions, without epistemological prejudice. There is a need to structure a field of ecological articulation of different types of knowledge and practices (Santos, 2006; Stengers, 1997), and to leverage them to achieve a true sustainability. Design for sustainability participates in the structuring of this transdisciplinary assembly of the various ecological discourses.

It is understood that ecology is an area of life sciences that provides a methodological perspective on other areas. The artist Agnes Denes, pioneer of environmental art and creator of the work exhibited at Broken Nature titled Wheatfield – A confrontation (figure 1), uses the term "eco--logic" to allude to this perspective and to an "eco-logical thinking" that brings together "philosophical concepts and ecological concerns" (Denes, 1993, p. 388, authors' translation ).

An ecological path would allow to rethink design and elaborate an ecodesign thinking in contrast to the available design approaches which have proved to be insufficient for the creation of effectively sustainable development models, if not the cause of their unsustainability. Given this, there is an understanding of the opportunity to conduct a metadesign review of the field, emphasizing bio and ecomimetic, as well as bio and ecophilic approaches. Such a review could begin by situating design within the ecologies of living systems (Capra, 1996), as well as knowledge and practices (Santos, 2006; Stengers, 1997), and proceed by enhancing its imaginative, co-creative, and prospective competencies to better serve the necessary regeneration of the ecologies of the mind, social relations, and the environment.

## 4. SCENARIOS OF SUSTAINABILITY

Scenarios are examples of the opportunity for convergence and transversal collaboration between formal disciplines and other practices and knowledge. With their roots in theater, scenarios can be associated with narrative processes practiced in different cultures for the transmission of intangible culture, the sharing of daily or exceptional events, collective discernment, divination, and the evaluation of paths to be undertaken.

In the middle of the last century, the concept was adopted by the interdisciplinary studies of futurology (Celaschi; Formia; Franzato, 2018) and taken as a future configuration of reality in which certain actors could take action. The scenario-building process is the speculative work of simulating possible futures through acts observation, prediction, anticipation, and representation to allow these actors to rehearse their eventual functions.

Throughout its evolution, the discourse on sustainability has become increasingly scenistic, especially with the improvement of the mathematical and statistical modeling of climatology, which has made it possible to accurately prospect the evolution of phenomena related to global warming. In this sense, the most famous example is the creation of the United Nations 2030 Agenda and the establishment of the 17 Sustainable Development Goals (UN, 2015).

Design also participates in futurology and the elaboration of the processes for scenario-building (Celaschi; Formia; Franzato, 2018; Franzato, 2023a). Among its specific contributions are works of imagination, representation, and socialization that contemplate new ethics and aesthetics, or rather, other ethics and aesthetics (Manzini; Jégou, 2003; Meroni, 2007; Silva; Bentz; Franzato, 2019; Franzato, 2020; 2022; 2003b).

Unlike the disciplines that interpret the scenario-building as a process of predicting futures and exploring the field of the probable, design can interpret it as a process of imagination and exploration of the field of the possible and even the impossible (Celi, 2010; Dunne; Raby, 2013; Celaschi, 2016; Franzato, 2023c). In design, traveling along the arrow of time often results in a creative strategy for achieving space-time deviations and locating a design project, not exactly in that same space, but in the future, in another space-time. Thus, design can move from this reality to another in search of effective otherness.

In the history of architecture and design, there are several examples of scenistic projects, such as Antonio Sant'Elia's futuristic visions for a New City (Città Nuova, Almeida, 2023), the Richard Buckminster Fuller's eco-science fictions of (1970), the technical fables of Archigram (Cabral, 2004), or the provocative experiments of Archizoom and other radical Italian design groups (Didero, 2017). Only at the end of the last century, however, did design begin to organize coherent methodological proposals. From the start, design for sustainability has made among the largest contributions to these developments (Manzini, 1990; Bergonzi, 1996), and the proposal made by the DESIS network can serve as an example (Manzini; Jégou, 2003; Meroni, 2007; Franzato, 2020).

Necessarily simplified, the DESIS network starts from the observation that the current development model is structurally unsustainable. To achieve sustainability, specific or incremental improvements, even if commendable, cannot be sufficient, and thus a systemic discontinuity of socio-technical organization is required. There is, however, an ideological element preventing proposals of this type from succeeding, namely, the view of well-being as a continuous increase in production and consumption. Confidence in technical progress interferes as well, which leads society in general and especially the design fields to undertake initiatives that allegedly strive towards sustainability, but which, in the end, reinforce the current structurally unsustainable model. Given this, design for sustainability comprehends the need to introduce a process of systemic social innovation that updates the understanding of well-being and socio-technical organization in order to ultimately achieve the objective of true sustainability.

Recalling Guattari's three ecologies, the proposal envisions the articulation of social innovation, sustainability, and well-being or better buen vivir (Acosta, 2016), taking into account that the term well-being is normally associated with consumption and comfort.

This way, the DESIS network seeks to create the conditions for the proposed change which can result "from a positive choice, instead of disastrous events or authoritarian impositions" that would arise "from a transformation perceived as an improvement in the living conditions of the people who live in them" (Manzini; Jégou, 2003, p. 45). Change should not be imposed or weigh on individuals or society but should rather be sought by them because it is within a view to a desirable future. Therefore, it is a proposal that works especially within the scope of symbolic production and with a potential for innovation that could be considered cultural even prior to being social.

## 5.PROCESS OF SCENARIO-BUILDING AND DESIGN NETWORKS

Twenty years ago, Ezio Manzini and François Jégou (2003) organized the exhibition Sustainable everyday. Scenarios of urban life at the Triennale di Milano to present the results of an archetypal process of scenario-building. In the catalog of the same name, which is still available online, the authors collected several methodological inputs for the building of scenarios, in addition to the results from the research and design experience (figure 5).

With some updates, this experience illustrates the four methodological movements articulating the scenario-building process. The first involves collecting, studying, and sharing inspiring cases, which originate from different contexts and can constitute a creative reference for developing scenarios (Manzini; Jégou, 2003; Meroni, 2007). These are sustainable projects and practices already consolidated in a given context, or else they are just prototypes often developed without the contribution of professional designers and which address issues related to the development of society in original ways, that is, without following pre-established standards. One of the exemplary cases in Sustainable everyday regarded urban gardens.

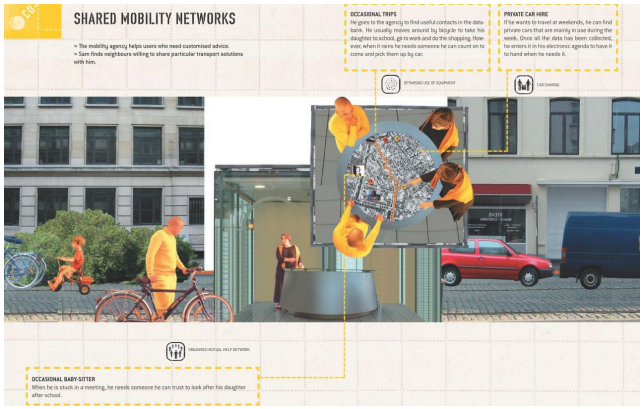


**Figure 5:** Shared Mobility Networks envisions a set of scenarios to offer solutions for mobility that enable residents to carry out their daily activities without resorting to private cars, or at least by using them collectively. It is an extension of the concept of Mobility Management. Specifically, Shared Mobility Networks envisions a mobility agency that helps users who need customized advice. **Source:** Manzini; Jégou; 2003, p. 196-197. Please, find a link to a higher resolution image here: https://prnt.sc/JlbwTceqsVOW

Then, the cases are organized to feed the second movement, that is, the elaboration of "co-creative workshops" (Manzini; Jégou, 2003) in which designers and other professionals, social innovation and sustainability actors, together with the general public all participate. In these workshops, scenarios are imagined, represented, and discussed collectively, and a series of design proposals derived from them, such as product-service systems (Vezzoli; Kothala; Srinivasa, 2018).

Therefore, social innovation and its effects on the search for sustainability can be expressed either where workshop participants take ownership of design proposals and implement them personally or when they manage to influence other people to implement them. Precisely for this reason, a third movement follows that is aimed at socializing and "amplifying" the cultural resonance of these proposals (Penin; Kobori; Forlano, 2012), for example, through the organization of events, the curation of exhibitions and catalogs (Manzini; Jégou, 2003; Meroni, 2007), the distribution of materials online and via open access, and the maintenance of social networks, etc.

The fourth movement is the "seeding" (Freire et al., 2020) of collected inspirations, constructed scenarios, and product-service systems derived from of existing relationships and by following unpredictable trajectories. This is a participatory process of innovation, not only open, but which foresees autonomous appropriations by the people to whom it opens. Examining the previous example now, twenty years later, urban gardens have sprung up around the world, and with a variety of scopes such as the efficient production of vegetables, food and agricultural education, and the collective occupation of interstitial urban spaces. Their spread is certainly not due to Sustainable everyday, but it cannot be denied that this may have contributed in some way considering that urban gardens still host educational and research projects from several design schools around the world. So that these four movements can provoke sustainability actions, note the importance given to the weaving of design networks, i.e., complex systems "of interwoven design processes, involving individual people, enterprises, non-profit organizations, local and global institutions who imagine and put into practice solutions to a variety of individual and social problems" (Jégou; Manzini; 2008, p. 40, authors' translation). Networking allows for connections among people with a variety of skills and is located in various organizational contexts, in order to bring their organizations into the design process and carry out a project (Franzato, 2017). Moreover, the design process structures the community and social relationships needed to implement the project (Hillgren; Seravalli; Emilson, 2011). Finally, networking makes it possible to expand the scope of design projects and connect with diverse geographic contexts thus allowing for cross-fertilization between the different ongoing processes and the distributed impact of their results.

Sustainable everyday suggested a path for other research and design experiences elaborated through scenistic practices. Many of the DESIS network activities employ similar methodological processes, such as Creative communities. People inventing sustainable ways of living, which is documented in a catalog organized by Anna Meroni (2007).

Putting these movements into practice allows them to spread beyond the DESIS network and eventually throughout the design field. A recent and quite relevant example is the project CreaTures. Creative Practices for Transformational Futures (CreaTures, 2020; Dolejšová, 2023). Its objectives are similar to those of Sustainable everyday or Creative communities experiences, and it proceeds by practicing four methodological movements with similar scopes. Creatures, however, differs from the previous ones in that it is more artistic, experimental, and performative in nature.

These processes often draw on the potential of fiction and expand into open-ended fantasies, as in the case of The Treaty of Finsbury Park 2025 (figure 6), though they maintain a commitment to ecological and transformative action. In fact, this commitment is maintained precisely through the work of images and symbolic production

that both design and art function within. Design research, then, can and should exercise this potential in daily practice and in the creation of communication artifacts and various initiatives to popularize science, such as through visual essays.

Figures 5 and 6 demonstrate the scenistic nature of this type of design project. The scope of the proposed scenario-building processes is primarily exploring, imagining, socializing and experiencing alternative ways of existing, of being with others, and of being in the world, i.e., "scenarios of sustainable well-being" (Manzini, 2003) scenarios of buen vivir (Acosta, 2016), scenarios of sumak kawsay, (Ecuador, 2008), scenarios of conviviality and sustainability (Illich, 1975; Franzato, 2022; 2023b; 2024) or, finally, ecotopias.

**Figure 6:** The Treaty of Finsbury Park 2025 is an immersive fiction that looks at what it would be like if other species were to rise up and demand equal rights with humans. It is part of an ambitious multi-year project by Furtherfield to promote biodiversity by reimagining the role of urban humans in greater collaboration with all the species of the London-based Finsbury Park. **Source:** https://creatures-eu.org/productions/treaty/

## 6. ECOTOPIAS SOCIOENVIRONMENTAL DESIGN LABORATORY

The conceptual bases related in this paper led to the review of the Socioenvironmental Design Laboratory at the Department of Arts & Design (dAD) at Pontifical Catholic University of Rio de Janeiro (PUC-Rio), now named Ecotopias (please, find the social networks profiles of the laboratory through the username @ecotopiaslab).

The department is one of the most prominent in the Latin American design field. Since its beginning in 1972, the department has been oriented towards design approaches related to the socioenvironmental responsibility of the designer and the participation of citizens both of which were emerging and considered alternatives and even antagonistic at the time. Notably, dAD hosted the Design for the Real World course by Professor Victor Papanek in May of 1980.

In 1994, dAD introduced the first Design Graduate Program in Latin America, marking the beginning of its research tradition. The Program was structured around various research laboratories, such as the EcoDesign Laboratory (Laboratório de EcoDesign, LED), founded by Professor Alfredo J. Oliveira in 2000. Driven by the three Rs of sustainability, the aim of the LED was to elaborate ecodesign methods and tools, integrating the scope of services into its field of operation and developing product-service systems.

In the early 2010s, LED underwent a process of review and updating, collaborating with researchers from architecture and urbanism at PUC-Rio and the Federal University of Minas Gerais (UFMG), and expanding its research on sustainability into the various field of the design culture. Thus, the Place Studies Group (Grupo de Estudos do Lugar, GEL) emerged, recognizing the city as a significant research theme and focusing on the development of Visions of Sustainability, which was the name of its seminars.

As a result of this process, which drove LED to increasingly focus on territorial design and social innovation, entering the spatio-social level of Ceschin and Gaziulusoy's diagram of the evolution of design for sustainability (figure 4). This way, in 2012, LED changed its name to Socioenvironmental Design Laboratory (Laboratório de Design Socioambiental, LDS). Notably, LDS contributed to and helped organize various editions of the Symposium on Sustainable Design.

At the end of 2021, Professor Carlo Franzato succeed the retired Professor Alfredo J. de Oliveira. He reinvigorated the work of LDS with the collaboration of Professors Augusto Seibel Machado, Bárbara de Oliveira e Cruz, Carlos Delano Rodrigues, Daniel Malaguti Campos, and Maria Eloisa de Jesus Conceição, along with students Adriana Basto Aquim, Clara Peixoto Acioli, Lia Moreira Astudillo Poblete, Natali Abreu Garcia, and Sofia Frant Pereira e Alvim.

During this process, the laboratory was renamed "Ecotopias", while retaining "Socioenvironmental Design Laboratory" in its description. The laboratory

was affiliated to the LeNS and DESIS networks, and registered in the Brazilian Directory of Research Groups, (http://dgp.cnpq.br/dgp/espelhogrupo/791990), with thefollowing summary:

> The Ecotopias Socioenvironmental Design Laboratory studies, develops, and practices design processes for social innovation and sustainability, inspired by ecology and oriented towards futures of conviviality and regenerative sustainability. From the perspective of complexity, Ecotopias contributes to the organization of networks of actors involved in the productive dynamics of society and their convergence in addressing the systemic crises that weaken the vitality of the planet. To do so, its processes favor collective discussions about current development models and possible alternatives, the imagination, anticipation and experimentation of different ways of being with others and being in the world, as well as the careful qualification of the ethos of the proposals developed. The core of its practices are the co-creation of eco--logical scenarios for action, that is, ecotopias (Ecotopias, 2023).



Within the scope of the laboratory, ecotopias are not necessarily ecological utopias, in other words, ideal and desirable visions that certainly challenge our actions but ultimately remain unattainable. Ecotopias are primarily eco-logical scenarios for action, meaning scenarios that are designed based on ecological principles and suggest actions for regenerating the ecologies of human subjectivity, social relationships, and the environment. For Ecotopias, ecology is both the starting point and the goal of design.

It is understood that ecology is an area of life sciences that provides a methodological perspective for other fields, including design. In fact, the available design approaches, both the more established ones and those proposing to surpass them, have proven to be insufficient for the development of genuinely sustainable models if they do not address the root causes of the unsustainability of current models. In this direction, the laboratory sees the opportunity to develop a bio and eco-inspired metadesign review of design which starts by repositioning design within the ecologies of knowledge and practices and proceeds to enhance its imaginative, co-creative, and prospective competencies to better serve the necessary reconfiguration of society.

## REFERENCES

ACOSTA, A. **O Bem Viver:** uma oportunidade para imaginar outros mundos**.** São Paulo: Editora Elefante, 2016. Disponível em: https://rosalux.org.br/wp-content/uploads/2017/06/Bemviver.pdf. Acesso em: 7 ago. 2023.

ALMEIDA, E. de. **L'Architettura Futurista: o manifesto de Antonio Sant'Elia**. arq.Urb, v. 9, p. 143–158. Disponível em: https://revistaarqurb.com.br/arqurb/article/view/371. Acesso em: 7 ago. 2023.

ANDERS, G. **Die Antiquiertheit des Menschen, Band 2:** Über die Zerstörung des Lebens im Zeitalter der dritten industriellen Revolution. Munich: Beck, 2002.

ANTONELLI, P. Broken Nature. In: ANTONELLI, P.; TANNIR, A. (orgs.). **Broken Nature:** Design Takes on Human Survival. XXII Triennale di Milano. Milano: Electa, 2019.

ANTONELLI, P.; TANNIR, A. (orgs.). **Broken Nature:** Design Takes on Human Survival. XXII Triennale di Milano. Milano: Electa, 2019.

BATESON, G. **Vers l'êcologie de l'esprit.** Paris: Seuil, 1980.

BERGONZI, F. Il design e il destino del mondo. Il prodotto filosofale. In: MAURI, F. (org.). **Progettare progettando strategia: il design del sistema prodotto**. Milano: Dunod, 1996. p. 155-232.

BISTAGNINO, L. **Design sistemico**. Progettare la sostenibilità produttiva e ambientale. Torino: Slow Food Editore, 2009.

BOFF, L. **Saber Cuidar:** Ética do humano - Compaixão pela Terra. Rio de Janeiro: Editora Vozes, 1999.

BRASIL. **Catálogo Nacional de Cursos Técnicos**. Brasília: MEC/SETEC, 2023. Disponível em: http://cnct.mec.gov.br/. Acesso em: 27 ago. 2023.w

BUCKMINSTER FULLER, R.; AGEL, L.; FIORE, Q. **I Seem To be a Verb.** New York: Bantam Books, 1970.

BUCKMINSTER FULLER, R.; APPLEWHITE, E. J. **Synergetics**: Explorations in the Geometry of Thinking. Vol. I e II. New York: Macmillan, 1975, 1979. Disponível em: http://www.rwgrayprojects.com/synergetics/synergetics.html. Acesso em: 5 jul. 2022.

CABRAL, C. P. C. Uma fábula da técnica na cultura do estado do bem-estar: Grupo Archigram, 1961-1974. **Cadernos de arquitetura e urbanismo**, v. 11, n.12, p. 247-263, 2004. Disponível em: http://periodicos.pucminas.br/index.php/Arquiteturaeurbanismo/article/view/861. Acesso em: 7 ago. 2023.

CAPRA, F. **A teia da vida.** São Paulo: Cultrix, 1996.

CELASCHI, F. Il tempo come dimensione del progetto. **Non industrial design**. Contributi al discorso progettuale. Roma: Luca Sossella editore, 2016. p. 43-69.

CELASCHI, F.; FORMIA, E.; FRANZATO, C. Back to the Future. Time and futures studies in the contemporary, design-driven approach to innovation. **diid | disegno industriale industrial design**, v. 16, p. 126-133, 2018. Disponível em: https://www.researchgate.net/. Acesso em: 26 ago. 2018.

CELI, M. **AdvanceDesign**. Visioni, percorsi e strumenti per predisporsi all'innovazione continua. Milano: McGraw-Hill, 2010.

CESCHIN, F.; GAZIULUSOY, I. Evolution of design for sustainability: from product design to design for system innovations and transitions. **Design Studies,** v. 47, p. 118-163, 2016. Disponível em: https://doi.org/10.1016/j.destud.2016.09.002. Acesso em: 27 ago. 2023.

COPERNICUS. **July 2023 sees multiple global temperature records broken.** 2023. Disponível em: http://bit.ly/3sTpcQ3. Acesso em: 27 ago. 2023.

CREATURES. **CreaTures:** Creative Practices for Transformational Futures. 2020. Disponível em: https://creatures-eu.org/. Acesso em: 1 ago. 2023.

DENES, A. **Notes on Eco-Logic:** Environmental Artwork, Visual Philosophy and Global Perspective. Leonardo, v. 26, n. 5, p. 387-395, 1993. Disponível em: https://doi.org/10.2307/1576033. Acesso em: 29 ago. 2023.

DIDERO, M. C. **Superdesign**: Italian Radical Design 1965-75. New York: Monacelli, 2017.

DOLEJŠOVÁ, M. (org.). **CreaTures Co-Laboratory Catalogue**. Experiences and outcomes of 20 experimental productions from the CreaTures research project. Espoo: Aalto PrintLab, 2023. Disponível em: https://doi.org/10.5281/zenodo.7525506. Acesso em: 1 ago. 2023.

DUNNE, A.; RABY, F. **Speculative everything**: design, fiction, And social dreaming. Cambridge: The MIT Press, 2013.

ECOTOPIAS. **Ecotopias.** Disponível em: http://dgp.cnpq.br/dgp/espelhogrupo/791990. Acesso em: 30 jun. 2024.

ELLEN MCARTHUR FOUNDATION. **Towards the Circular Economy.** Vol. 1: Economic and Business Rationale for an Accelerated Transition. Cowes: Ellen McArthur Foundation, 2013. Disponível em: https://bit.ly/3RizAuJ. Acesso em: 27 ago. 2023.

ENGELHARDT, H. T. **The foundations of bioethics**. New York: Oxford, 1996.

EQUADOR. **Constitución de la República del Ecuador.** Quito: Asamblea Nacional de Equador, 2008. Disponível em: https://www.asambleanacional.gob.ec/es/contenido/constitucion_de_la_republica_del_ecuador_reformada. Acesso em: 29 ago. 2023.

ESCOBAR, A. **Designs for the Pluriverse:** Radical Interdependence, Autonomy, and the Making of Worlds. Durham: Duke University Press, 2018.

FLETCHER, K. Slow Fashion: An Invitation for Systems Change. **Fashion Practice,** v. 2, n. 2, p. 259-266, 2010. Diponível em: https://bit.ly/46acbjg. Acesso em: 5 jul. 2022.

FRANCISCO. **Carta Encíclica Laudato Si'.** Sobre o Cuidado da Casa Comum. Roma: Editrice Vaticana, 2015. Disponível em: https://bit.ly/46w51pV. Acesso em: 28 jul. 2023.

FRANZATO, C. Redes de projeto: formas de organização do design contemporâneo em direção à

sustentabilidade. In: OLIVEIRA, A. J.; FRANZATO, C.; DEL GAUDIO, C.; (Org.). **Ecovisões projetuais:** pesquisas em design e sustentabilidade no Brasil. São Paulo: Editora Blucher, 2017, p. 99-110. Disponível em: https://bit.ly/46eQVc2. Acesso em: 26 ago. 2018.

FRANZATO, C. Diseño estratégico para la innovación social y la sostenibilidad. **Estudos em design**, v. 28, n. 1, p. 27-37, 2020. Disponível em: https://doi.org/10.35522/eed.v28i1.882. Acesso em: 5 jul. 2022.

FRANZATO. C. **Contribuições do design estratégico ao design para a sustentabilidade.** Mix Sustentável, v. 8, n. 4, p. 87-95, 2022. Disponível em: https://doi.org/10.29183/2447-3073.MIX2022.v8.n4.87-95. Acesso em: 2 set. 2022.

FRANZATO, C. **Processos de construção de cenários no planejamento estratégico e no design estratégico.** Gestão & Tecnologia de Projetos, v. 18, n. 1, p. 219-237, 2023a. Disponível em: https://www.revistas.usp.br/gestaodeprojetos/article/view/198547. Acesso em: 7 ago. 2023.

FRANZATO, C. **Representação em processos participados de construção de cenários: a experiência da rede DESIS.** Revista Educação Gráfica, v. 27, n. 1, p. 380-399, 2023b. Disponível em: https://rb.gy/hzs6m. Acesso em: 7 ago. 2023.

FRANZATO, C. **Cenários no desenvolvimento de coleção de moda:** da tradição do design industrial à imaginação. Modapalavra, v. 16, n. 39, p. 1-12, 2023c. Disponível em: https://doi.org/10.5965/1982615x16392023e0007. Acesso em: 8 nov. 2023.

FRANZATO, C. **Toward a Convivial Design.** DesignIssues, v. 40, n. 1, p. 31-44, 2024. Disponível em: https://doi.org/10.1162/desi_a_00742.

FREIRE, K. M. DEL GAUDIO, C.; BENTZ, I. M. G.; FRANZATO, C.; BORBA, G. S. **Design estratégico e seeding para promover processos ecossistêmicos de inovação social.** Centro de Estudios en Diseño y Comunicación, n. 83, p. 111-125, 2020. Disponível em: https://doi.org/10.18682/cdc.vi83.3733. Acesso em: 20 set. 2022.

FRY, T. **Design Futuring:** Sustainability, Ethics, And New Practice. Randwick: UNSW Press, 2009.

FRY, T.; NOCEK, A. **Design in Crisis:** New Worlds, Philosophies and Practices. London: Routledge, 2020
.
FRY: T. Defuturing. **A New Design Philosophy.** London: Bloomsbury, 2020.

FUAD-LUKE, A. **Design Activism:** Beautiful Strangeness for a Sustainable World. London: Earthscan, 2013. Disponível em: https://designopendata.wordpress.com. Acesso em: 5 jul. 2022.

GALIMBERTI, U. **Psiche e techne.** L'uomo nell'età dela tecnica. Milano: Feltrinelli, 1999.

GARCIA, N. A.; FREIRE, K. M.; FRANZATO, C. **Princípios e movimentos para processos projetuais regenerativos**. Mix Sustentável, v. 9, n. 2, 2023. Disponível em: https://doi.org/10.29183/2447-3073.MIX2023.v9.n2.63-74. Acesso em: 20 set. 2023.

GEBARA, I. **Teologia ecofeminista:** ensaio para repensar o conhecimento e a religião. São Paulo: Olho d'Água, 1997.

GUATTARI, F. **The three ecologies**. London: The Athlone Press, 2000.

HANH, T. N. **The World We Have**. Berkeley: Parallax Press, 2009.

HEIDEGGER, M. **A questão da técnica.** Scientiae Studia, v. 5, n. 3, p. 375-398, 2007. Disponível em: http://www.scientiaestudia.org.br/revista/PDF/05_03_05.pdf. Acesso em: 28 jul. 2023.

HILLGREN, P.-A.; SERAVALLI, A.; EMILSON, A. **Prototyping and infrastructuring in design for social innovation.** CoDesign, v. 7, n. 3–4, 2011, p. 169–183. Disponível em: https://doi.org/10.1080/15710882.2011.630474. Acesso em: 26 ago. 2018..

IAIRNO JOSE CHIMBO AGUINDA, I. J.; ULLAURI VELASCO, M. A.; SHLGUANGO ANDI, E. E. **Shimiyukkamu.** Diccionario: kichwa-español, español-kichwa. Quito: Casa de la Cultura Ecuatoriana Benjamín Carrión, 2007

ILLICH, I. **A convivencialidade.** Lisboa: Europa-América, 1976.

IRWIN, T. **Transition Design:** A Proposal for a New Area of Design Practice, Study, And Research. Design and Culture, v. 7, n. 2, p. 229-246, 2015. https://doi.org/10.1080/17547075.2015.1051829. Acesso em: 5 abr. 2022

JÉGOU, F.; MANZINI, E. **Collaborative services.** Social Innovation and Design for Sustainability. Milano: Polidesign, 2008. Disponível em: https://www.strategicdesignscenarios.net/collaborative-services-book/. Acesso: 26 ago. 2018.

JONAS, H. **O princípio responsabilidade.** Ensaio de uma ética para a civilização tecnológica. Rio de Janeiro: Contraponto, PUC-Rio, 2006.

KRENAK, A. **Futuro Ancestral**. São Paulo: Companhia das Letras, 2022.

LATOUR, B. **Um Prometeu cauteloso?** Alguns passos rumo a uma filosofia do design (com especial atenção a Peter Slotedijk). Agitprop, v. 6, n. 58, sem páginas, 2014. Disponível em: https://bit.ly/3Zn9AR0. Acesso em: 28 jul. 2023.

MALDONADO, T. **La speranza progettuale.** Torino: Einaudi, 1970.

MANG, P.; REED, B. **Regenerative Development and Design.** In: MEYERS, R.A. (org.). Encyclopedia of Sustainability Science and Technology. New York: Springer, p. 8855-8879, 2012.

MANZINI, E. Artefatti. **Verso una nuova ecologia dell'ambiente artificiale.** Milano: Domus Academy, 1990.

MANZINI, E.; JÉGOU, F. (orgs.) S**ustainable Everyday. Scenarios of urban life**. Milano: Edizioni Ambiente, 2003. Disponível em: https://www.strategicdesignscenarios.net/sustainable-everyday-book/. Acesso em: 5 jul. 2022.

MANZINI, M. **Scenarios of Sustainable Wellbeing.** Design Philosophy Papers, v. 1, n. 1, p. 5-21, 2003. Disponível em: https://doi.org/10.2752/144871303X13965299301434. Acesso em: 5 jul. 2022.

MERONI, A. **Creative communities**. People inventing sustainable ways of living. Milano: Polidesign, 2007. Disponível em: https://www.strategicdesignscenarios.net/creative-communities-book/. Acesso em: 26 ago. 2018.

PAPANEK, V. **Design for the Real World:** Human Ecology and Social Change. New York: Pantheon Books, 1971.

PENIN, L.; KOBORI, M.; FORLANO, L. **Amplifying Creative Communities New York City.** New York: Parsons DESIS lab, 2012. Disponível em: http://www.amplifyingcreativecommunities.org/AmplifyBook.pdf. Acesso em: 26 ago. 2018.

SANTOS, B. S. A **gramática do tempo:** para uma nova cultura política. São Paulo: Cortez, 2006.

SBMET. **Phenomenon Catarina in Debate.** 2005. Disponível em: https://bit.ly/459Gg1H. Acesso em: 28 jul. 2023.

SILVA, C. P.; BENTZ, I. M. G.; FRANZATO, C. **Utopias/distopias e heterotopias em dispositivos de design:** reflexão metaprojetual sobre Casas Colaborativas. Estudos em design, v. 27, p. 163-179, 2019. Disponível em: https://doi.org/10.35522/eed.v27i3.779. Acesso em: 28 jul. 2023.

SIMONDON, G. **Du mode d'existence des objets techniques**. Paris: Aubier, 1989.

STENGERS, I. **Cosmopolitiques I. La guerre des sciences.** Paris: La Découverte, 1997.

THACKARA, J. **In the Bubble:** Designing in a Complex World. Cambridge: MIT Press, 2005.

UN. **Objetivo do desenvolvimento sustentável 11:** cidades e comunidades sustentáveis. 2015. Disponível em: https://brasil.un.org/pt-br/sdgs/11. Acesso em: 5 jul. 2022.

VEZZOLI, C.; KOTHALA, C.; SRINIVASA, A. **Sistema produto + serviço sustentável.** Curitiba: Insight, 2018. Disponível em: https://bit.ly/3RlZduu. Acesso em: 28 jul. 2023.

WAHL, D. C. **Design de Culturas Regenerativas.** Rio de janeiro: Editora Bambual, 2020.

WHO. **Mental health of adolescents.** 2021. Disponível em: https://www.who.int/news-room/fact-sheets/detail/adolescent-mental-health. Acesso em: 13 jul. 2023.

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# COMPORTAMENTO DE CONSUMO SUSTENTÁVEL: SLOW FASHION NO BRASIL

## *SUSTAINABLE CONSUMPTION BEHAVIOR: SLOW FASHION IN BRAZIL*

## *COMPORTAMIENTO DE CONSUMO SOSTENIBLE - MODA LENTA EN BRASIL*

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**ABSTRACT**

*The interest in social justice and sustainability issues in the fashion industry has grown exponentially in recent years, given the concern for the worldwide preservation of the natural goods that remain on the earth and the valorization of professionals in the production chain. Slow fashion emerges as a relevant movement in this context. It seeks to slow down the mass industrial production of the fashion area that is currently known by overriding the valuing of quality and people who work throughout the production chain to the detriment of quantity and exploitation of natural resources. This paper aims to verify whether the five dimensions (equity, localism, exclusivity, functionality, and authenticity) of the Consumer Orientation to Slow Fashion (COSF) scale fit satisfactorily to Brazil and then draw profiles of slow fashion product consumption in this exact scenario. Thus, we planned and applied a virtual questionnaire using the COSF scale with 414 volunteers from Brazil. We treated the collected data by exploratory and confirmatory factor analysis, k-means, structural equation modelling, and analysis of variance. As a result, we observed that the COSF scale did not thoroughly adjust to the Brazilian context, where the dimension of functionality did not reach a minimum factor loading to be considered in the subsequent analyses. Thus, we identified three orientation profiles for slow fashion consumption: averse to exclusivity, highly, and low orientation.*

**KEYWORDS**

*Slow fashion; Consumption; Fair trade; Sustainability; COSF scale*

***RESUMO***

O interesse pelas questões de justiça social e sustentabilidade na indústria da moda tem crescido exponencialmente nos últimos anos, dada a preocupação com a preservação mundial dos bens naturais que permanecem na terra e a valorização dos profissionais da cadeia produtiva. O Slow fashion surge como um movimento relevante neste contexto. Busca desacelerar a produção industrial em massa da área da moda que hoje é conhecida por passar por cima da valorização da qualidade e das pessoas que atuam em toda a cadeia produtiva em detrimento da quantidade e da exploração dos recursos naturais. Este artigo tem como objetivo verificar se as cinco dimensões (equidade, localismo, exclusividade, funcionalidade e autenticidade) da escala de Orientação do Consumidor para Slow fashion (COSF) se ajustam satisfatoriamente ao Brasil e então traçar perfis de consumo de produtos Slow fashion neste exato cenário. Assim, planejamos e aplicamos um questionário virtual utilizando a escala COSF com 414 voluntários do Brasil. Os dados coletados foram tratados por análise fatorial exploratória e confirmatória, k-médias, modelagem de equações estruturais e análise de variância. Como resultado, observamos que a escala COSF não se ajustou completamente ao contexto brasileiro, onde a dimensão funcionalidade



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não atingiu uma carga fatorial mínima a ser considerada nas análises subsequentes. Assim, identificamos três perfis de orientação para o consumo Slow fashion: averso à exclusividade, alta e baixa orientação..

***PALAVRAS CHAVE***
Moda lenta; Consumo; Fair trade; Sustentabilidade; Escala COSF

## RESÚMEN

*El interés por temas de justicia social y sostenibilidad en la industria de la moda ha crecido exponencialmente en los últimos años, dada la preocupación por la preservación global de los bienes naturales que quedan en la tierra y el reconocimiento de los profesionales de la cadena productiva. El slow fashion surge como un movimiento relevante en este contexto. Se busca frenar la producción industrial masiva en el sector de la moda. Este artículo tiene como objetivo verificar si las cinco dimensiones de la escala Orientación del Consumidor a la Moda Slow (COSF) se ajustan satisfactoriamente a Brasil y luego delinear perfiles de consumo de productos de moda Slow en ese escenario exacto. Por ello, planificamos y aplicamos un cuestionario virtual utilizando la escala COSF con 414 voluntarios de Brasil. Los datos fueron tratados mediante análisis factorial exploratorio y confirmatorio, k-medias, modelado de ecuaciones estructurales y análisis de varianza. Como resultado, observamos que la escala COSF no se ajustó completamente al contexto brasileño. Así, identificamos tres perfiles de orientación para el consumo de moda Slow.*

***PALABRAS CLAVE***

*Moda lenta; Consumo; Comercio justo; Sostenibilidad; Escala COSF*

## 1. INTRODUCTION

In an increasingly connected and immediate world, fashion is not left behind when it comes to meeting the desires and needs of consumers, who yearn for products that are delivered quickly and efficiently (Joy et al., 2015). This massive demand is quickly supplied through a business model called fast fashion. Solino et al. (2015, p. 1036, translated by us) explain that fast fashion "can unite the quick-response productive strategy with the use of advanced resources for product design," in addition, they complement by explaining that it offers "current trends quickly and effectively in the form of products with short life cycle and low cost." As a result of its quick response to the market, this fashion production system emphasizes mass consumption, encouraging environmental wear and tear and human labor exploitation.

As an alternative to this production model, the slow fashion (SF) movement arises from the slow food movement, acting as a possibility to bring ideas of sustainability, ethics, and respect for human beings to the dynamics of the fashion industry (Fletcher, 2008). Based on Fletcher (2008; 2010), the precursor of slow fashion, it can be defined as a movement that aims to design, produce, consume, and live fashion more healthily, considering environmental, social, ethical, and moral sustainability and the impact of your clothing production on the world. .

Considering that slow fashion is a research area with just over ten years of exploration, its studies of practical applications were only enhanced in 2018 (Solino, Teixeira, and Dantas, 2020). Initially, the researchers aimed to understand and conceptualize the phenomenon (Fletcher, 2008); then, there was an increase in empirical research characterizing companies and consumers. With this in mind, we did not find any work discussing the Brazilian consumer's general orientation towards slow fashion products; therefore, it has not yet been understood scientifically or from a marketing point of view.

In-depth knowledge about the consumer is a crucial element for the success of any business. According to Porter (2015), understanding consumers' needs, desires, and behaviors is essential for formulating effective market strategies. This understanding allows companies to identify market opportunities, develop products and services that meet consumers' needs, and create marketing and sales strategies that effectively connect with their target audience. In addition, consumer knowledge can also help companies predict and respond to changes in consumer behavior and market trends.

From a management perspective, consumer knowledge is essential for making informed and strategic decisions. As argued by Drucker (2017), companies that understand their consumers can better manage their resources effectively, adapt to changes in the business environment, and maintain a competitive advantage. In marketing, Kotler and Keller (2018) emphasize that consumer knowledge is the basis for developing effective marketing campaigns that communicate the value of a company's products and services in a way that resonates with consumers. Finally, in product development, Ulrich and Eppinger (2020) argue that consumer knowledge is crucial for designing products that meet consumers' needs and expectations, contributing to customer satisfaction and product success in the market.

Research in the area of consumer perception and orientation of slow fashion started in the studies by Jung and Jin (2014), where the authors defined five dimensions that guide their consumption, namely: a) equity, referring to the gaze of consumers on the payment of fair values to everyone involved in the production chain; b) authenticity, about the valorization of artisanal and traditional techniques; c) functionality, dealing with maximizing the practical potential of the product; d) localism, aiming to discover the orientation to the valorization of what is produced on a local scale over imported products; e) exclusivity, about the need to own products that no one else has. The authors developed a scale format method based on these dimensions to measure consumers' orientation towards slow fashion products (Jung and Jin, 2016a).

Called "Consumer Orientation to Slow Fashion" (or COSF), the scale developed by Jung and Jin (2014) seeks to discover the purchase possibilities of consumers of fashion products from the slow fashion movement and identify the dimensions that guide this consumer in a specific environment. This scale was applied in other countries (Şener, Bişkin, and Kılınç, 2019), where the orientation of consumers in Turkey and Kazakhstan was discussed and in the study by Suhud et al. (2020), in which Indonesia was investigated.

Concerning Brazil, this scale was first applied and validated by Sobreira, Silva, and Romero (2020), but the authors investigated only Ceará, a Brazilian state, not expanding the work focusing on the entire country. The authors (Sobreira, Silva, and Romero, 2020) investigated a total of 461 volunteers; with this, the researchers discovered the existence of three consumption profiles: "high orientation to slow fashion," "functionality-oriented," and "averse to exclusivity."

In Brazil, slow fashion is a response to fast fashion's rapid and unsustainable production, which significantly negatively impacts the environment and working communities. Brazilian slow fashion, therefore, seeks to promote more sustainable and ethical production and consumption practices, valuing quality, durability, and social justice (Fiorin, Sehnem, and Mattei, 2020). This includes, for example, using sustainably sourced materials, promoting fair and safe working conditions, and promoting more conscious and responsible consumption (Fiorin, Sehnem, and Mattei, 2020).

Furthermore, slow fashion in Brazil is also characterized by a strong emphasis on valuing Brazilian culture and identity. Assunção, Martinez, and Jacques (2021) pointed out that Brazilian slow fashion brands incorporate Brazilian culture and aesthetics into their designs to celebrate and preserve the country's cultural diversity. In addition, these brands also seek to promote inclusion and diversity, challenging conventional standards of beauty and promoting a more inclusive and diverse view of fashion. Thus, slow fashion in Brazil is not just a question of sustainability, identity, and inclusion.

However, we argued that there is a possibility to understand which aspects are inherent to slow fashion that these consumers tend to value the most in the Brazilian scenario. This information can be captured by understanding and discussing the perception and orientation of products' practical, aesthetic, and symbolic functions resulting from the slow movement in the local context. The contributions of this paper are threefold:

- Characterize the slow fashion consumption in Brazil based on its dimensions.
- Draw slow fashion consumption profiles in Brazil.
- Indicate demographic characteristics for slow fashion consumption profiles in Brazil.

Based on what we discussed above, this work aims to verify if the scale of orientation to slow fashion consumption satisfactorily adjusts to the context of Brazil and, subsequently, to draw consumption profiles of SF products in this exact scenario.

This paper is organized as follows: in addition to this first section, dedicated to the contextualization and theoretical basis of the research, section 2 focuses on the methodological procedures of the study. In section 3, we present the work results, starting with the statistical adjustment of the scale and variables to the Brazilian scenario and ending with the definition of the profiles. In section 4, we discuss the theoretical implications of the study, while section 5 presents the managerial implications. Section 6 finally demonstrates the study's conclusions and possible future research.

## 2. METHODOLOGY

Regarding the instrument for data collection, we used the psychometric scale developed by Jung and Jin (2014), called the Consumer Orientation to Slow Fashion (COSF), as explained above in the introduction topic. In the scale composition, the authors considered fifteen items consisting solely of statements, subdivided among the five dimensions of the SF: equity, authenticity, functionality, localism, and exclusivity (Table 1).

### 2.1. Research instrument - "Consumer Orientation to Slow Fashion" (COSF) scale

| Consumer Orientation to Slow Fashion scale (COSF) |
|---|
| **Equity** |
| Equi.1 – I am concerned about the working conditions of producers when I buy clothes. |
| Equi.2 – I am concerned about fair trade when I buy clothes. |
| Equi.3 – Fair compensation for apparel producers is important to me when I buy clothes. |
| **Authenticity** |
| Auten.1 – Handcrafted clothes are more valuable than mass-produced ones. |
| Auten.2 – Craftsmanship is very important in clothes. |
| Auten.3 – I value clothes made by traditional techniques. |
| **Functionality** |
| Func.1 – I tend to keep clothes as long as possible rather than discarding quickly. |
| Func.2 – I often enjoy wearing the same clothes in multiple ways. |
| Func.3 – I prefer simple and classic designs. |
| **Localism** |
| Loc.1 – I believe clothes made of locally produced materials are more valuable. |
| Loc.2 – I prefer buying clothes made in Brazil to clothes manufactured overseas. |
| Loc.3 – We need to support Brazilian apparel brands. |
| **Exclusivity** |
| Exclu.1 – Limited editions hold special appeal for me. |
| Exclu.2 – I am very attracted to rare apparel items. |
| Exclu.3 – I enjoy having clothes that others do not. |

**Table 01:** Consumer Orientation to Slow Fashion scale

The COSF scale was previously validated in Brazil, focusing on the Brazilian state of Ceará through Sobreira, Silva, and Romero (2020). Therefore, in this research, the aim is to investigate the consumption orientation profiles of

Brazilians in general from a new perspective.

We created the virtual questionnaire using the Google Forms platform, which is self-administered. The questionnaire consisted of three stages. In the first stage, respondents were asked to read about the research and accept the Informed Consent Form. After this stage, in the second stage, questions regarding the sociodemographic profile were presented to the participants, consisting of nine questions: gender, sexual orientation, marital status, age, ethnicity, Brazilian region, academic-school education, work situation, and monthly income.

The third stage referred to a perception survey containing the Consumer Orientation to Slow Fashion scale (COSF) (Table 1). Each item was presented to the respondents and asked to rate their level of agreement considering a five-point Likert scale, where number one corresponded to "strongly disagree" and five to "strongly agree."

### 2.2. Participants

Men and women aged from less than 18 years to more than 60 years participated in the research. Regarding the most apparent sociodemographic profile, it was primarily female (72.3%), aged between 19 and 29 years (41.1%), heterosexually oriented (74.6%), single (69.6%), white (61.6%), mainly from the Brazilian Northeast (65.9%), with higher education (48.1%), active professional in the market (55.8%) and with income of less than BRL 1,000 per month (26.3%). The complete data can be seen in Table 2.

| Category | *N = 414* | Category | *N = 414* |
|---|---|---|---|
| **Gender** | **72,3% = Female**<br>27,1%= Male<br>0,7% = Other | **Brazilian region** | 0,7% = North<br>**65,9% = Northeast**<br>5,3% = Midwest<br>1,9% = South<br>26,2% = Southeast |
| **Age** | 8% = Under 18 years old<br>**41.1% = 19 to 29 years old**<br>33.8% = 30 to 39 years<br>6.3% = 40 to 49 years old<br>7.5% = 50 to 59 years old<br>3.4% = Over 60 years old | **Academic education** | 0.7% = Elementary school<br>17.4% = High School<br>**48.1% = Higher education**<br>19.6% = Specialization<br>8.2% = Master's<br>6% = Doctorate<br>Specialization<br>8.2% = Master's<br>6% = Doctorate |
| **Sexual orientation** | 11.6% = Homosexual<br>12.3% = Bisexual<br>**74.6% = Heterosexual**<br>1.5% = Others | **Work situation** | **55.8% = Active** professional<br>9.9% = Unemployed<br>30.7% = Student<br>3.6% = Retired |
| **Marital status** | **69.6% = Single**<br>25.1% = Married<br>4.3% = Divorced<br>1% = Widowed | **Race/Color/ Ethnicity** | **61.6% = White**<br>5.3% = Black<br>31.6% = Brown<br>1.2% = Yellow<br>0.2% = Indigenous |
| **Monthly income** | **26,3% = Less than BRL 1.000**<br>15,2% = BRL 2.000 to BRL 3.000<br>8,7% = BRL 4.000 to BRL 5.000<br>4,6% = More than BRL 10.000<br>---<br>22,7% = BRL 1.000 to BRL 2.000<br>6,5% = BRL 3.000 to BRL 4.000<br>15,9% = BRL 5.000 to BRL 10.000 | | |

**Table 02:** Sociodemographic characterization of the participants

### 2.3. Analysis and treatment of data

The data were submitted to statistical analysis software, such as Statistical Package for Social Sciences (SPSS) version 20, IBM SPSS Amos, and XLAST. In addition to the basic descriptive analysis, we used four data treatment techniques: exploratory factor analysis (EFA) and confirmatory factor analysis (CFA), clustering by k-means, and analysis of variance (ANOVA), as observed in other published works on the same subject (Jung and Jin, 2014; Jung and Jin, 2016a; Jung and Jin, 2016b; Şener, Bişkin and Kilinç, 2019; Sobreira, Silva and Romero, 2020).

## 3. FINDINGS

### 3.1. Consumer Orientation to Slow Fashion scale adjusted to Brazil

Initially, we conducted a confirmatory factor analysis (CFA) on the data referring to the Consumer Orientation to Slow Fashion (COSF) scale to verify the validity of its application in this research, identifying whether its complete model fits the data found. As explained in the introduction, the authors (Jung and Jin, 2014) divided the scale into five latent dimensions/variables: equity, authenticity, functionality, localism, and exclusivity. Each dimension is configured according to three observed variables, forming fifteen items to consider in the factor analysis.

We identified that the standardized factor loadings were more significant than 0.5 for only four of the five variables studied (equity, authenticity, localism,

and exclusivity) of the slow fashion consumption. The functionality dimension did not fit satisfactorily. In this context, we observed that only one of the three items in the functionality dimension had the minimum factor loading to consider. The items in this section of the scale showed a total Cronbach's Alpha of 0.37, which indicates that the slow fashion scale based on a five-dimensional orientation (COSF) proposed by Jung and Jin (2014) does not necessarily fit the Brazilian scenario in its entirety to the data collected in this research.

Chin (1998) and Hair et al. (2019) presented that those variables with factor loadings or Cronbach's Alpha below 0.7 should be discarded, as they can compromise the other research data. Based on this, the functionality dimension was disregarded in the context of this research, forming a reduced version of the COSF scale. After these delimitations, the final structural model of the AFC can be seen in Figure 1, alongside the adjustment metrics.

Source: Prepared by the authors according to research data. Note: adjustment metrics: X2 = 126,378 (p < 0,001); Df = 48; X2/df = 2.63; GFI = 0,95; RMSEA = 0,06; AGFI = 0,92; CFI = 0,95



Considering the results, we could verify that the structural model satisfied the statistical adiustment of the

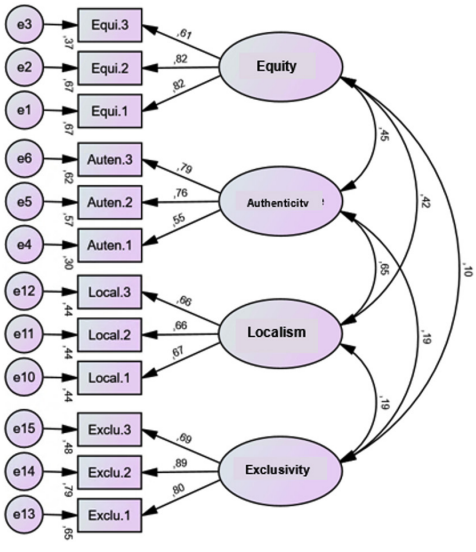


**Figure 01:** Final model of the confirmatory factor analysis for the Brazilian context digital design, etc. Source: Prepared by the authors according to research data. **Note:** adjustment metrics: X2 = 126,378 (p < 0,001); Df = 48; X2/df = 2.63; GFI = 0,95; RMSEA = 0,06; AGFI = 0,92; CFI = 0,95

data based on all processed indicators (Hair et al., 2009). Therefore, we observed that the CFA model proved adequate for this study, allowing researchers to proceed to the subsequent analysis steps – confirmatory factor analysis.

Given the validity of the planned structural model, in a more specific way, Table 3 below shows the estimates of the standardized factor loadings obtained from the CFA, the standardized error, and the statistical significance of the relationship between the items of the latent variable. The values of discriminant validity (DV), Cronbach's alpha (α), and composite reliability coefficient (CR) for each analyzed dimension are also exposed.

| | Stan. Est. | Stan. Error | p-value |
|---|---|---|---|
| **Equity (α = 0,785; CR = 0,795; DV = 0,569)** | | | |
| Equi.1 – I am concerned about the working conditions of producers when I buy clothes. | 0,817 | - | - |
| Equi. 2 – I am concerned about fair trade when I buy clothes. | 0,817 | 0,071 | *** |
| Equi. 3 – Fair compensation for apparel producers is important to me when I buy clothes. | 0,609 | 0,047 | *** |
| **Authenticity (α = 0,735; CR = 0,746; DV = 0,501)** | | | |
| Auten. 1: Handcrafted clothes are more valuable than mass-produced ones. | 0,552 | - | - |
| Auten. 2: Craftsmanship is very important in clothes. | 0,758 | 0,164 | *** |
| Auten. 3: I value clothes made by traditional techniques. | 0,789 | 0,167 | *** |
| **Localism (α = 0,694; CR = 0,700; DV = 0,438)** | | | |
| Loc. 1: I believe clothes made of locally produced materials are more valuable. | 0,665 | - | - |
| Loc. 2: I prefer buying clothes made in Brazil to clothes manufactured overseas. | 0,660 | 0,105 | *** |
| Loc. 3: We need to support Brazilian apparel brands. | 0,660 | 0,083 | *** |
| **Exclusivity (α = 0,834; CR = 0,841; DV = 0,641)** | | | |
| Exclu. 1: Limited editions hold special appeal for me. | 0,804 | - | - |
| Exclu. 2 I am very attracted to rare apparel items. | 0,890 | 0,072 | *** |
| Exclu. 3 I enjoy having clothes that others do not. | 0,695 | 0,068 | *** |

**Table 03:** Confirmatory Factor Analysis on the Consumer Orientation to Slow Fashion Scale for Brazil

Cronbach's alpha (α), when greater than 0.5, indicates the internal reliability of the items that make up the scale (George and Malleri, 2003). Thus, it was found that all

items in this study have a value greater than 0.5, being reliable. Table 4 shows the levels of correlation between the dimensions of the slow fashion scale. According to Table 4, we can observe that equity has a higher correlation with authenticity (0.449) and lower with exclusivity (0.103), this being the only covariance that did not show a significant result at 5% probability (p>0.05). Authenticity correlates more with localism (0.650) and lower for exclusivity (0.188). Localism correlates more with authenticity (0.650) and lower with exclusivity (0.192). Finally, exclusivity correlates more with localism (0.192) and less with equity (0.103).

The scale's discriminant validity results were also accepted, where the square root of the dimension's discriminant validity values must be greater than the correlation estimate between these two constructs in all cases (Fornell and Larcker, 1981; Jung and Jin, 2016b). Considering the results presented so far in this paper, we can conclude that the structural model of the reduced-to-Brazilian version of the Consumer Orientation to Slow Fashion scale, which features 12 items and four dimensions, can be considered reliable, valid and adjustable to the collected data, being able to proceed to the subsequent phases of the analyses.

| Dimensions | Equity | | Authenticity | | Localism | | Exclusivity | |
|---|---|---|---|---|---|---|---|---|
| Equity | **0,754** | | | | | | | |
| Authenticity | 0,449 | *** | **0,707** | | | | | |
| Localism | 0,422 | *** | 0,650 | *** | **0,661** | | | |
| Exclusivity | 0,103 | * | 0,188 | ** | 0,192 | ** | **0,800** | |

**Table 04:** Confirmatory Factor Analysis on the Consumer Orientation to Slow Fashion scale for Brazil. – Values in bold refer to each dimension's square root of the DV. Red means non-significant value. Green means significant value. ***p-value < 0.01, **p-value < 0.05, *p-value < 0.10.

### 3.2. Identification of slow fashion consumption profiles in the Brazilian scenario

To delimit consumption profiles aimed at the slow fashion from the collected data, the k-means grouping technique was used, applying the Euclidean distance method (Kuswandi et al., 2018). For constructing these classes, we considered the respondents' interaction relationships with the four dimensions of slow fashion that apply to the context of this research: equity, authenticity, localism, and exclusivity.

One of the k-means technique assumptions is that the analyst must define the number of groups/clusters/profiles to generate. In previous research on the same subject, Jung and Jin (2016b) defined four groups, while Sobreira, Silva, and Romero (2020) defined three as appropriate. To define the amount that would apply in this work, we decided on a minimum of three and a maximum of four groups using the XLSTAT software.

We observed the characteristics of each grouping possibility. After the preliminary analysis, it was found that both had significant results; however, the definition by three groups represented a segmentation with more significant variance. Thus, we considered the grouping into three profiles of orientation to the consumption of slow fashion products in the context of this research (Table 5).

| Dimensions | Averse to exclusivity (Cluster 1) | High orientation (Cluster 2) | Low orientation (Cluster 3) | Anova | |
|---|---|---|---|---|---|
| | | | | F | Sig. |
| Equity | 4,456 | 4,410 | 3,135 | 294,730 | < 0,0001 |
| Authenticity | 3,898 | 4,447 | 3,920 | 19,250 | < 0,0001 |
| Localism | 3,947 | 4,241 | 3,775 | 4,050 | 0,018 |
| Exclusivity | 1,867 | 3,789 | 2,640 | 250,377 | < 0,0001 |
| **Orientation** | Medium, lower for exclusivity | High | Low | **Participants** 414 | |

**Table 05:** Comparison of averages between slow fashion consumption-oriented profile clusters in Brazil

In the research by Jung and Jin (2016b), the authors identified four consumption profiles, which they called: "high involvement", "conventional", "exclusivity-oriented", and "low involvement". On the other hand, in the research by Sobreira, Silva, and Romero (2020), focusing on the Ceará scenario, the Brazilian state, three groups different from the other authors' proposal were observed configuring: "high orientation," "functionality-oriented" and "averse to exclusivity." In the context of this work, we identified three groups – those that were conceptually correlated at certain levels with those previously found in the literature review – namely: "averse to exclusivity," "high orientation", and "low orientation."

Regarding the configurations of each cluster, the first group was called "averse to exclusivity" (n = 141; 34%). This group has a medium orientation average in all other three dimensions, with a lesser focus on authenticity; however, it presents an exceptional refusal when consumption involves rare, limited-edition pieces that few people have (exclusivity). It is also worth noticing a slightly lesser tendency towards authenticity, demonstrating that this group does not care much about handcrafted or traditional sewing techniques. This group opposes the "exclusivity-oriented" profile identified in the work of Jung and Jin

(2016b). However, this same group was found in Sobreira, Silva, and Romeiro's (2020) research, demonstrating a tendency in Brazil to have a group that refuses the context of exclusivity in slow fashion products.

In the case of the second cluster, we called "high orientation" (n = 160; 39%), the group with the highest number of respondents. This group comprises people with a higher orientation towards consuming slow fashion products, with a high average in all dimensions studied. There is also a greater focus on authenticity; however, unlike the previous one, there is a positive attitude towards handmade clothes and handcrafted products. Therefore, they present a lesser orientation towards exclusivity, although this was the only cluster with a positive average for this dimension. This same group was found in Jung and Jin (2016) and Sobreira, Silva, and Romeiro (2020), with the same characteristics.

Finally, the third cluster was called "low orientation" (n = 113; 27%), comprising the group with the smallest number of individuals. It comprises people with little orientation to all slow fashion product consumption dimensions. The authenticity dimension is highlighted as having a more positive relationship with this group, demonstrating that, despite the resistance to consumption, its components tend to be more interested when there is a context of traditional techniques and crafts. On the other hand, like the other clusters, the dimension of exclusivity was the one with the lowest level of orientation. This group was also identified in the research by Jung and Jin (2016b), named "low involvement", but not in the research by Silveira, Silva, and Romeiro (2020).

As shown in Table 3, there is statistical significance for all dimensions of slow fashion orientation, which indicates the validity of the results for the context of this research. After ANOVA, to identify where the differences between the groups and their respective dimensions were located, the post hoc test of Turkey HSD was conducted, comparing two generated clusters (Table 6).

in all dimensions, except equity, compared to the second cluster (high orientation). Regarding the third cluster (low orientation), compared to the first (averse to exclusivity), a statistically significant difference was identified ($p<0.05$) in all dimensions except for authenticity. Comparing the second (high orientation) and third (low orientation) clusters, we found a statistically significant difference ($p<0.001$) among all dimensions of orientation to the consumption of SF.

### 3.3. Comparison of slow fashion groups for sociodemographic variables in the Brazilian context

To formalize a comparison between demographic variables and consumption profiles aimed at slow fashion, we sought to conduct an analysis of variance (ANOVA) for each of the sociodemographic categories requested in the initial phase of the research, such as gender, age, sexual orientation, marital status, ethnicity, academic background, work status, and monthly income. Using a cross-reference table, we compare the categories that did not show a statistically significant difference. We intended to trace the sociodemographic characteristics within the three groups, allowing for a more in-depth discussion of the particularities and patterns within each cluster.

Concerning gender, no statistically significant differences were identified ($F = 0.670$, $df = 2$, $p > 0.05$) between this variable and the orientation groups to slow fashion consumption, indicating no guided orientation profile based on the genre. However, for the "high orientation" group, we observed a more significant quantitative presence of binary genders (male, n = 44, and female, n = 116, respectively). In contrast, individuals categorized as 'others' (n = 2), who did not identify with gender binarity, were more quantitatively related to the "averse to exclusivity" group (Figure 2).

| Groups | | Equity | | Authenticity | | Localism | | Exclusivity | |
|---|---|---|---|---|---|---|---|---|---|
| (A) | (B) | (A-B) | Sig. | (A-B) | Sig. | (A-B) | Sig. | (A-B) | Sig. |
| 1 | 2 | 0,458 | 0,653 | -0,549 | 0,000 | -0,293 | 0,000 | -1,922 | 0,000 |
| 1 | 3 | 1,320 | 0,000 | 0,022 | 0,938 | 0,172 | 0,030 | -0,592 | 0,000 |
| 2 | 3 | 1,274 | 0,000 | 0,527 | 0,000 | 0,465 | 0,000 | 1,329 | 0,000 |

**Table 06** Comparison of averages between slow fashion consumption-oriented profile clusters in Brazil

According to the results presented in Table 6, we observed that the first cluster (averse to exclusivity) demonstrates a statistically significant difference ($p<0.001$)

Regarding sexual orientation, no statistically significant differences were identified ($F = 0.270$, $df = 2$, $p > 0.05$) between groups with an orientation towards slow fashion

consumption. We also observed that respondents with heterosexual orientation were mainly related to the "high orientation" group (n = 119) and homosexuals (n = 19). Bisexuals were more related to the "averse to exclusivity" group (n = 22).

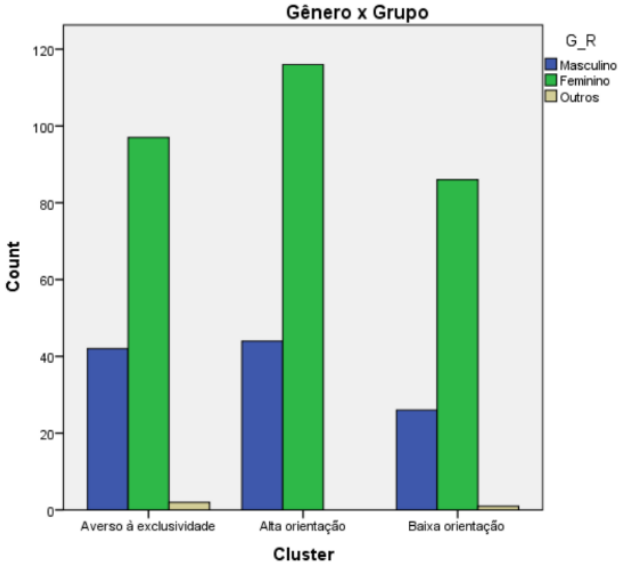


**Figure 02**: Slow fashion consumption clusters by gender in Brazil. **Source:** Prepared by the authors according to research data

Identifying any statistically significant difference (F = 2.147, df = 2, p > 0.05) between this variable and the orientation profiles towards slow fashion consumption regarding the respondents' marital status was impossible. Despite this result, we identified that single respondents (n = 113) and married (n = 42) were more related to the "high orientation" group. Divorced people were positively related to both "averse to exclusivity" (n = 7) and "low orientation" (n = 7). Widowers (n = 2) were more related to "low orientation".

Regarding the comparison between groups with an orientation towards the consumption of slow fashion and the ethnicity of respondents, no statistically significant difference was found (F = 0.774, df = 2, p > 0.05). In a quantitative sense, all respondents, when observed by their ethnicity, showed a tendency towards the "high orientation" group (n = 95 (white), n = 55 (brown), n = 2 (yellow), and n = 1 (indigenous)), except for the black category, which was mainly related to the "averse to exclusivity" group (n = 10).

Concerning academic-school training compared to the profiles of consumption orientation in a slow fashion, it was identified that there is no statistically significant difference (F = 0.109, df = 2, p > 0.05). It was possible to observe a trend in most categories for the "high orientation" group (n = 2 (primary education), n = 31 (high school), n = 35 (specialization), and n = 12 (doctorate)), except for the category of people from higher education and master's, who showed a quantitative predisposition to the group "averse to exclusivity" (n = 82 and n = 15, respectively).

Regarding the work situation, it was impossible to identify any statistically significant difference (F = 0.013 df = 2, p > 0.05) for the orientation profiles to consumption of slow fashion. It was observed that the categories of professionals active in the market, unemployed, and students had a quantitative relationship to the "high orientation" group (n = 88, n = 16, and n = 51, respectively). While the retired category they were more positively related to the "low orientation" group (n = 6).

Regarding the different age groups compared to the slow fashion consumption-oriented profiles, it was identified that there is no statistically significant difference (F = 0.779, df = 2, p > 0.05). It was observed that the categories under 18 years old, from 30 to 39 and over 60, found themselves focused on "high orientation" (n = 20, n = 56, and n = 7, respectively). Volunteers aged 19 to 29 years tended to be "averse to exclusivity" (n = 67), while people aged 40 to 49 and 50 to 59 turned to "low orientation" (n = 12 and n = 11, respectively) (Figure 3).

Finally, regarding the monthly income of respondents, it was impossible to identify any statistically significant difference (F = 0.207, df = 2, p > 0.05) to the profiles of consumption orientation of slow fashion products. The respondents in the categories with a monthly income of less than BRL 1,000.00 (n = 47), from BRL 2,000.00 to BRL 3,000.00 (n = 25), from BRL 4,000.00 to BRL 5,000.00 (n = 14) and from BRL 5,000.00 to BRL 10,000.00 (n = 26) were focused on "high orientation" group. Volunteers with monthly income of BRL

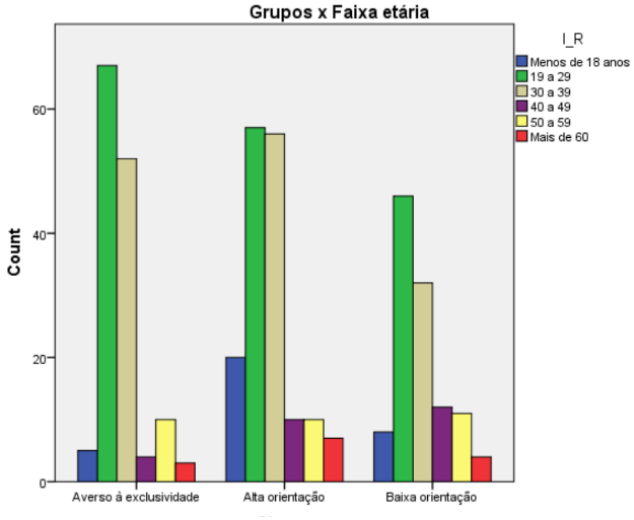


**Figure 03:** Slow fashion consumption clusters by age in Brazil. **Source:** Prepared by the authors according to research data.

1,000.00 to BRL 2,000.00 and BRL 3,000.00 to BRL 4,000.00 were more positively related to the "averse to exclusivity" group (n = 35 and n = 10, respectively), as well as those with monthly income above R$10,000.00 (n = 8).

According to the data presented above, it can be concluded that, in the context of this research, none of the demographic variables tested had a statistically significant influence on the profiles of consumption orientation of slow fashion products. Those results indicate that drawing a unique sociodemographic profile for each delimited SF orientation group was impossible.

## 4. THEORETICAL IMPLICATIONS

The findings of this study have several theoretical implications. Firstly, the study highlights the importance of understanding consumer profiles in the context of slow fashion (SF) consumption. The Identification of three distinct consumer profiles – "averse to exclusivity", "high orientation", and "low orientation" – suggests that consumers' attitudes towards SF are not homogenous. This aligns with the consumer behavior theory, which posits that consumers' attitudes and behaviors are influenced by various factors, including personal values, beliefs, and social influences (Solomon, 2014).



Secondly, the study's findings challenge the assumption that all dimensions of SF consumption are equally relevant across different cultural contexts. The functionality dimension, for instance, did not statistically adjust satisfactorily to the Brazilian scenario. This suggests that the relevance of different dimensions of SF consumption may vary across different cultural contexts, consistent with the cultural theory of consumption (Arnould & Thompson, 2005).

Thirdly, the study's findings suggest that equity, localism, and authenticity are essential for the "averse to exclusivity" group. This supports the notion that consumers' attitudes towards SF are influenced by their perceptions of fairness, localism, and authenticity (Niinimäki & Hassi, 2011). This group's positive relationship with these dimensions suggests that they value fair trade, locally produced goods, and authentic products.

Fourthly, the "high orientation" group's positive orientation to all dimensions of SF consumption, with a higher level for the authenticity dimension, and less for exclusivity, suggests that this group values authenticity more than exclusivity. This aligns with the authenticity theory of consumption, which posits that consumers increasingly seek authentic experiences and products (Gilmore & Pine, 2007).

Fifthly, the "low orientation" group's average below the general average in all dimensions of SF suggests that this group may be less engaged with SF. However, their better relation to the dimensions of authenticity and localism suggests that they may be potential traditionalists. This aligns with the traditionalist theory of consumption, which posits that some consumers prefer traditional products and practices (Sheth, Newman & Gross, 1991).

Sixthly, the study's inability to statistically relate demographic variables to these groups suggests that demographic factors may not be significant predictors of consumers' attitudes towards SF. This challenges the demographic theory of consumption, which posits that demographic factors significantly influence consumer behaviors (Wells and Tigert, 1971).

The study's implications for the national apparel industry suggest that understanding consumers' attitudes towards SF can inform product development strategies. This aligns with the market orientation theory, which posits that understanding consumers' needs and preferences can enhance firms' competitiveness (Kohli & Jaworski, 1990).

Finally, the study's limitation regarding the distribution of volunteers across all Brazilian states suggests that its findings may not be generalizable to the entire Brazilian population. This highlights the importance of representative sampling in consumer research, as posited by the sampling theory (Sudman, 1976).

## 5. MANAGERIAL IMPLICATIONS

The managerial implications of this study are manifold and can provide valuable insights for businesses operating in the slow fashion (SF) industry, particularly in Brazil.

Firstly, the Identification of three distinct consumer profiles - "averse to exclusivity", "high orientation", and "low orientation" – can help businesses segment their market and tailor their marketing strategies accordingly. For instance, businesses can target the "averse to exclusivity" group with marketing messages emphasizing equity, localism, and authenticity. For the "high orientation" group, businesses can highlight all dimensions of SF consumption, emphasizing authenticity. For the "low orientation" group, businesses can focus on promoting the authenticity and localism of their products.

Nevertheless, understanding that today the creation process increasingly seeks to develop a production

model centred on the user/target audience, knowing the desires, perceptions, and what adds value to future consumers is essential to obtain satisfactory results (Löbach, 2001). Thus, if designers had access to safer data about users' aesthetic, symbolic and practical needs, product designs would have fewer launch risks, as they would be based on rationally taken decisions based on statistical data (Löbach, 2001).

Secondly, the finding that the functionality dimension did not adjust satisfactorily to the Brazilian scenario suggests that businesses should not overly focus on this dimension in their marketing efforts. Instead, they should prioritize other more relevant dimensions to the Brazilian context, such as equity, localism, and authenticity.

Thirdly, the inability to statistically relate demographic variables to these groups suggests businesses should not rely solely on demographic factors when segmenting their market and developing their marketing strategies. Instead, they should consider other factors, such as consumers' attitudes towards SF and their orientation to different dimensions of SF consumption.

Fourthly, the study's implications for the national apparel industry suggest that businesses can leverage these insights to develop SF products that cater to the preferences of different consumer groups. This can enhance their competitiveness and help them meet the growing demand for SF products.

Finally, the study's limitation regarding the distribution of volunteers across all Brazilian states suggests that businesses should be cautious when generalizing these findings to the entire Brazilian population. They should consider conducting their own market research to better understand their target market's attitudes towards SF.

In conclusion, this study provides valuable insights that can help businesses in the SF industry better understand their consumers, tailor their marketing strategies, and develop products that meet their consumers' needs and preferences.

## 6. FINAL CONSIDERATIONS

It was concluded that the functionality dimension did not statistically adjust satisfactorily to the Brazilian scenario, so a reduced scale was applied in the analyses, disregarding the use of this dimension. Three were observed regarding the profiles of orientation to the consumption of SF. We found averse to exclusivity, high orientation, and low orientation.

In summary, the group "averse to exclusivity" was positively related to equity, localism, and authenticity, the latter being at a lower level. In contrast, the "high orientation" group was found to be positively orientated to all dimensions of SF consumption, with a higher level of authenticity and less for exclusivity. The "low orientation" group has an individual average below the general average in all dimensions of slow fashion. In comparison, it was better related to the dimensions of authenticity and localism, which makes them be read as potential traditionalists. It was impossible to statistically relate the demographic variables to these groups, so drawing a profile based on this information was impossible.

The results of this research imply social developments, where trends in how consumption has been developing can be observed and correlated with consumer preferences; with that, the national apparel industry can appropriate this information and plan slow fashion products that have their configurations oriented to these groups of consumers. It ends by saying that one of the limitations of this research was that there was not a normal distribution of volunteers among all Brazilian states. Based on this, it is concluded that its results cannot be generalized, as they do not represent the perception of a probabilistic sample of the Brazilian population.

For future work, it is possible to go deeper into questions referring only to the value perceived by the customer, appropriating the PERVAL scale and measuring the influence of the dimensions of quality, emotion, price, behavior, and reputation on the purchase intention. In addition, one can also investigate the visual attributes, and aesthetic aspects, used in the visual language of slow fashion products, tracing which elements are most used to refer to the ecologically oriented and if this has a significant relationship in the purchase of products. From this, one can also focus on the visual quality perceived by customers, comparing the intention with the interpretation.



## REFERENCES

Arnould, E. J., & Thompson, C. J. (2005). C**onsumer Culture Theory (CCT): Twenty Years of Research. Journal of Consumer Research**, 31(4), 868-882.

Assunção, L. F., Martinez, A. K., & Jacques, J. J. de. (2021). **Discursos éticos e estéticos: uma análise semiótica de editoriais fotográficos de marcas de fast fashion e slow fashion.** Modapalavra E-periódico, 14(32), 73-97.

Drucker, P. (2017). **The Practice of Management.** Harper & Row.

Fiorin, M. M. B., Sehnem, A., & Mattei, L. F. (2020). **Vestuário sustentável: análise das características do modo de produção Slow Fashion em empresas brasileiras**. Organizações e Sustentabilidade, 8(1), 75–91.

Fletcher, K. (2008). **Sustainable Fashion and Textiles: Design Journeys**. Milton Park, Abingdon, Oxon: Routledge.

Fletcher, K. (2010). **Slow fashion: An Invitation for Systems Change**. Fashion Practice, 2(2), 259-265.

Fowler, F. J. (2014). **Survey research methods**. 5. ed. Los Angeles: Sage.

Gilmore, J. H., & Pine, B. J. (2007). **Authenticity: What Consumers Really Want.** Harvard Business School Press.

Hair, J. F. et al. (2009). **Multivariate Data Analysis**. 7. ed. New York: Pearson.

Hooper, D., Coughlan, J., & Mullen, M. (2008). **Structural Equation Modelling: Guidelines for Determining Model Fit.** Electronic Journal of Business Research Methods, 6(1), 53-60.

Joy, A., Sherry Jr., J. F., Venkatesh, A., Wang, J., Chan, R. (2015). **Fast Fashion, Sustainability, and the Ethical Appeal of Luxury Brands**. Fashion Theory, 16(3), 273-295.

Jung, S., & Jin, B. (2014). **A theoretical investigation of slow fashion: sustainable future of the apparel industry.** International Journal of Consumer Studies, 38(5), 510-519.

Jung, S., & Jin, B. (2016a). **Sustainable Development of Slow fashion Businesses: Customer Value Approach. Sustainability,** 8(6), 540.

Jung, S., & Jin, B. (2016b). **From quantity to quality: understanding slow fashion consumers for sustainability and consumer education**. International Journal of Consumer Studies, 40(4), 410-421.

Kohli, A. K., & Jaworski, B. J. (1990). **Market Orientation: The Construct, Research Propositions, and Managerial Implications.** Journal of Marketing, 54(2), 1-18.

Kotler, P., & Keller, K. L. (2018). **Marketing Management. Pearson**.

Kuswandi, D. et al. (2018). **Means Clustering of Student Perceptions on Project-Based Learning Model Application.** Proceedings of the International Conference on Education and Technology, 4(2018), 9-12.

Löbach, B. (2001) **Design industrial: bases para a configuração dos produtos industriais.** São Paulo: Edgard Blucher.

Magrani, E. (2019). **Entre dados e robôs: ética e privacidade na era da hiperconectividade.** Porto Alegre: Arquipélago.

Niinimäki, K., & Hassi, L. (2011). **Emerging Design Strategies in Sustainable Production and Consumption of Textiles and Clothing.** Journal of Cleaner Production, 19(16), 1876-1883.

Porter, M. (2015). **Competitive Strategy: Techniques for Analyzing Industries and Competitors.** Simon and Schuster.

Şener, T., Bişkin, S. F., & Kilinç, N. (2019). **Sustainable dressing: Consumers' value perceptions towards slow fashion.** Business Strategy and the Environment, 28(8), 1548-1557.

Sheth, J. N., Newman, B. I., & Gross, B. L. (1991). **Why We Buy What We Buy: A Theory of Consumption Values.** Journal of Business Research, 22(2), 159-170.

Sobreira, E. M. C., Silva, C. R. M., & Romero, C. B. A. (2020). **Slow profile: estudo das orientações ao consumo de slow fashion.** Internext - Revista Eletrônica de Negócios Internacionais, 153, 103-127.

Solino, L. J. S. et al. (2015). **Fast-Fashion: uma revisão**

**bibliográfica sistemática e agenda de pesquisa.** Revista Produção Online, 15(3), 1021–1048.

Solino, L. J. S., Teixeira, B. M. L., & Dantas, Í. J. M. (2020). **The sustainability in fashion: a systematic literature review on slow fashion**. International Journal for Innovation Education and Research, Dhaka, Bangladesh, 8(10), 164–202.

Solomon, M. R. (2014). **Consumer Behavior: Buying, Having,** and Being. Pearson.

Sudman, S. (1976). **Applied Sampling**. Academic Press.

Suhud, U. et al. (2020). **Slow fashion in Indonesia: Drivers and Outcomes of Slow fashion Orientations**. Research in World Economy, 11(6), 27-37.

Ulrich, K., & Eppinger, S. (2020). **Product Design and Development.** McGraw-Hill Education.

Wells, W. D., & Tigert, D. J. (1971). **Activities, Interests and Opinions. Journal of Advertising Research,** 11(4), 27-35.

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# EL PAISAJE DE LA PRODUCCIÓN MARÍTIMO-INDUSTRIAL EN FLORIANÓPOLIS: EL ASTILLERO ARATACA, PATRIMONIO Y PROYECTO

## *A PAISAGEM DA PRODUÇÃO MARÍTIMO-INDUSTRIAL EM FLORIANÓPOLIS: O ESTALEIRO ARATACA, PATRIMÔNIO E PROJETO.*

## *THE LANDSCAPE OF MARINE-INDUSTRIAL PRODUCTION IN FLORIANÓPOLIS: THE ARATACA SHIPYARD, HERITAGE AND PROJECT*

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**RESUMEN**

Este artículo forma parte de una investigación realizada por el Grupo de Investigación de Proyecto, Patrimonio, Percepción y Paisaje, afiliado a la Universidad Federal de Santa Catarina - UFSC, en Brasil. La región de la Gran Florianópolis posee vestigios de un valioso patrimonio industrial en desuso y, en este sentido, seleccionamos aquí las ruinas del Estaleiro Arataca, cerca del puente Hercílio Luz, para un estudio más detallado. Esto se debe a que esta investigación es una parte de un proyecto de investigación más amplio que aquí se destaca para integrar trabajos en los campos de arquitectura e ingeniería, centrándose en el relevamiento, análisis e intervención en un patrimonio industrial en un punto emblemático de la capital de Santa Catarina. Una forma integral de concebir un proyecto para su rehabilitación. Por lo tanto, este trabajo es la oportunidade para la comprensión del contexto histórico y su transformación en una acción conjunta y sostenible. Queremos comprender la importancia del complejo como un hito de la época marítimo-industrial en la cabecera insular de la Isla de Santa Catarina y, además, conocer más sobre su nuevo contexto a través de la práctica de caminar. La comprensión de su espacialidad se logra a través de cartografías, así como el diagnóstico de las patologías constructivas de estos edificios. Nuestro objetivo es crear un proyecto que reinterpreta el papel de las ruinas en la ciudad, dándole a este espacio la capacidad de poner en marcha iniciativas culturales, artísticas y digitales sin menospreciar los usos actuales. Un lugar que sea alternativo, creativo y abierto a la invención.

**PALABRAS CLAVE**

Proyecto; Patrimonio; Paisaje.

***RESUMO***

*Este artigo faz parte de uma pesquisa realizada pelo Grupo de Pesquisa Projeto, Patrimônio, Percepção e Paisagem, afiliado à Universidade Federal de Santa Catarina - UFSC, no Brasil. A região da Grande Florianópolis possui vestígios de um valioso patrimônio industrial em desuso e, nesse sentido, selecionamos aqui as ruínas do Estaleiro Arataca, perto da ponte Hercílio Luz, para um estudo mais detalhado. Isso se deve ao fato de que esta pesquisa é parte de um projeto de pesquisa mais amplo que se destaca aqui para integrar trabalhos nos campos da arquitetura e engenharia, focando no levantamento, análise e intervenção em um patrimônio industrial em um ponto emblemático da capital de Santa Catarina. Uma forma integral de conceber um projeto para sua reabilitação. Portanto, este trabalho é a*



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*oportunidade para a compreensão do contexto histórico e sua transformação em uma ação conjunta e sustentável. Queremos entender a importância do complexo como um marco da época marítimo-industrial na cabeceira insular da Ilha de Santa Catarina e, além disso, conhecer mais sobre seu novo contexto através da prática de caminhar. A compreensão de sua espacialidade é alcançada através de cartografias, bem como o diagnóstico das patologias construtivas desses edifícios. Nosso objetivo é criar um projeto que reinterprete o papel das ruínas na cidade, dando a este espaço a capacidade de impulsionar iniciativas culturais, artísticas e digitais sem desconsiderar os usos atuais. Um lugar que seja alternativo, criativo e aberto à invenção.*

## *KEYWORDS*
*Projeto; Patrimônio; Paisagem.*

## *ABSTRACT*
*This article is part of a research project by the Research Group for Design, Heritage, Perception, and Landscape, affiliated with the Federal University of Santa Catarina - UFSC, in Brazil. The Greater Florianópolis region holds remnants of a rich, disused industrial heritage. In this regard, we have selected the ruins of the Arataca Shipyard, located near the Hercílio Luz Bridge, for a more detailed study. This investigation is a segment of a broader research project that is being extracted to contribute to works in the fields of architecture and engineering. The focus is on surveying, analyzing, and intervening in an industrial heritage site, situated at a significant point in the capital of Santa Catarina. It represents an integrated approach to conceptualize a project for its rehabilitation. Thus, this work aims to understand the historical context and its transformation into a collaborative and sustainable action. We seek to grasp the importance of this complex as a marker of the maritime-industrial era on the insular headland of Santa Catarina Island. Additionally, we intend to learn more about its new context through the practice of walking. Understanding its spatiality involves cartography, as well as diagnosing the structural pathologies of these buildings. Our objective is to create a project that reinterprets the role of these ruins within the city, empowering this space to facilitate cultural, artistic, and digital initiatives without undermining its current uses. A place that is alternative, creative, and open to innovation.*



## *KEYWORDS*
*Project; Heritage; Landscape.*

## 1. INTRODUCCIÓN

Este artículo se enmarca en una investigación realizada por el Grupo de Investigación de Proyecto, Patrimonio, Percepción y Paisaje, afiliado a la UFSC - Universidad Federal de Santa Catarina, Campus de Florianópolis, en Brasil. Articula investigaciones integradas en los campos de la arquitectura y la ingeniería, centrándose en el ámbito del patrimonio para dar un salto en la creación de un proyecto para un antiguo edificio industrial en la cabecera de la Isla de Santa Catarina. Esto es especialmente relevante frente a los cambios ocurridos en el momento presente en el ámbito del arte, la cultura, la tecnología y el medio ambiente.

En el panorama actual de la Gran Florianópolis, encontramos algunos vestigios de patrimonio arquitectónico industrial en desuso en la región metropolitana, en su centro histórico y en la costa de la Lagoa da Conceição. En este contexto, elegimos las ruinas del Estaleiro Arataca, junto al famoso puente colgante Hercílio Luz, debido a su ubicación central y altamente emblemática en el paisaje histórico de la ciudad, además de formar parte de estudios pasados y de investigaciones en curso de profesores y diversos alumnos involucrados en la temática.

Hasta hace poco, la Isla de Santa Catarina se podía entender en dos partes: su área central, donde surgió la población de Nossa Senhora do Desterro y donde se concentran las actividades portuarias, comerciales y administrativas del Estado; y las regiones interiores, donde predominan las funciones agrícolas y pesqueras. Estas características están fuertemente ligadas al flujo migratorio de familias provenientes de los territorios portugueses del Archipiélago de las Azores y de la Isla de Madeira, asentamientos que dejaron sus huellas culturales en el territorio insular de Santa Catarina.

El fenómeno embrionario de su metropolitanización vino con la ampliación de la accesibilidad de la región central y de sus núcleos aislados, así como el estímulo de sus nuevas funciones regionales, como una nueva sede de balnearios y capital turística del cono sur. Los procesos de modernización de Florianópolis, incluida la construcción de nuevos puentes y rellenos, erosionaron las antiguas actividades industriales que solían estar cerca del agua y se sumaron a la obsolescencia de su puerto.

En el contexto actual, las ruinas del Estaleiro Arataca, debajo del puente Hercílio Luz, son el último testimonio de ese floreciente período marítimo-industrial que no ha sufrido ninguna intervención. Nuestro objetivo en este artículo es desarrollar una lectura histórica que destaque este ejemplar de la época industrial. A través de cartografías, buscamos realizar un análisis de las ruinas desde la perspectiva de su espacialidad arquitectónica, así como evaluar la viabilidad tecnológica para su rehabilitación, mediante un diagnóstico de sus patologías constructivas. Esto se debe a que este campo de la ingeniería civil ayuda a identificar, analizar y monitorear las deficiencias constructivas presentes en los edificios, como grietas, filtraciones y deformaciones, entre otras, lo que contribuye a la realización de un proyecto que respalde la rehabilitación de este patrimonio marítimo-industrial en la ciudad de la Isla de Santa Catarina.

En consecuencia, hemos construido un compendio histórico, espacial y técnico para proponer una idea de reintegración de los edificios en la trama urbana existente, diversificando su uso para la comunidad mediante su vocación espacio-cultural, plataformas de creación y/o fabricación en el ámbito digital. Los resultados buscan implementar un proyecto de rehabilitación que se apoye en las ruinas de la época industrial para construir los nuevos espacios de la era digital. Así, vamos a levantar, analizar y proponer una forma de intervención en este patrimonio industrial que pueda resultar en una apuesta factible, que considere un enfoque crítico capaz de agregar nuevos significados al paisaje histórico de la producción en la Gran Florianópolis, en un momento de desarrollo tecnológico y sostenible. Una respuesta que no se cierra en sí misma, porque está abierta a la invención.



## 2. EL ASTILLERO ARATACA Y EL PAISAJE HISTÓRICO DE LA PRODUCCIÓN MARÍTIMO-INDUSTRIAL

La ciudad de Nossa Senhora do Desterro, actualmente conocida como Florianópolis, fue establecida en la parte insular de la bahía sur con el propósito de proteger el pueblo de los invasores. La presencia constante del "viento del sur" hacía que el simple desplazamiento de barcos que transportaban personas y mercancías hacia los muelles y los puntos de anclaje de las áreas centrales siempre fuera un desafío. Dependiendo de las condiciones climáticas, también atracaron cerca del Fuerte de Santana, mucho más cerca de la bahía norte (VEIGA, 2004, p. 39).

La posición geográfica de la cabecera de la Isla de Santa Catarina, ubicada entre las bahías norte y sur y alejada del centro de la ciudad, dio origen a un puerto de gran importancia. Un personaje emblemático en este nuevo contexto espacial fue el inmigrante alemán Carl Hoepcke. Como joven socio de una empresa comercial,

percibió la necesidad de expandir el comercio de la Isla de Santa Catarina con el resto del mundo. En 1895, fundó la "Empresa Nacional de Navegación Hoepcke", una compañía de navegación. Además de hacer posible fletes más accesibles para las mercancías importadas de Europa, que vendía en sus tiendas, Hoepcke vislumbra la oportunidad de impulsar el transporte marítimo de pasajeros.

Con el tiempo, el comerciante se convirtió en el principal propietario de varias embarcaciones, expandiendo sus negocios y construyendo un modesto parque industrial entre las dos bahías de la Isla de Santa Catarina. Este complejo industrial incluía una aldea obrera y albergaba la producción de una variedad de productos, desde clavos para el ensamblaje de equipos importados y reparación de barcos, hasta la fabricación de hielo, encajes y bordados, en otras instalaciones fabriles cercanas al puerto (REIS, 1999, p. 99).

La visión emprendedora de Carl Hoepcke impulsó el desarrollo económico de la región, trayendo nuevas oportunidades para el comercio y la industria en la Isla de Santa Catarina. Su papel como pionero en la navegación y la industrialización contribuyó a la consolidación del puerto y al crecimiento de la economía local. El legado de Hoepcke como empresario visionario y promotor del desarrollo industrial dejó una marca perdurable en la historia de la isla y en su camino hacia convertirse en un puerto y polo industrial importante en la región. El puerto y todo lo que lo rodeó dieron vida a la ciudad y provocaron un crecimiento económico cada vez mayor." (REIS, 1999, p. 109).



**Figura 01:** Mapa y Cuadrícula de Fotos Históricas del Astillero Arataca.
**Fuente:** Autores, Grupo de Pesquisa P4, 2023.

Durante el inicio del siglo XIX, el flujo de cargas y pasajeros entre Río de Janeiro y Florianópolis estaba en constante aumento. Conscientes de esta creciente demanda, las empresas Hoepcke decidieron emprender la construcción de un astillero, inicialmente destinado a la reparación de barcos, pero que luego extendió sus actividades a la fabricación de veleros. La elección del lugar para su implantación recayó en una bahía encantadora y pintoresca, de aproximadamente 200 metros de longitud, situada cerca del puerto, entre el Fuerte de Santana y sus Fábricas de Hielo y Pontas de Paris Rita Maria, conocida como Playa de Arataca. En 1907, se concretiza la construcción del Astillero Arataca, diseñado por el entonces ingeniero alemán von Ockel, compuesto por cinco edificaciones distintas: los galpones fabriles, las talleres, los depósitos y una pequeña casa (REIS, 1999, p. 134).

El puerto de Florianópolis enfrentaba desafíos debido a su escaso calado, lo que dificulta la llegada de grandes barcos. Además, en 1926, la construcción del puente Hercílio Luz llevó gradualmente a la migración de las rutas comerciales y de pasajeros al transporte por carretera, lo que resultó en una disminución en la importancia de la navegación. Este cambio se vio agravado por la deficiencia de las grúas en la zona portuaria (VEIGA, 2010, p. 282). Aunque las fábricas circundantes continuaron funcionando durante algún tiempo, el transporte de carga y pasajeros por vía marítimo disminuyó gradualmente a lo largo de la segunda mitad del siglo XX.

Como resultado de esta transformación, algunas de las antiguas fábricas fueron posteriormente convertidas en centros comerciales y empresariales, adaptándose a los nuevos tiempos. Sin embargo, el astillero Arataca permaneció como una ruina, un testimonio silencioso del pasado industrial de la región. Su estructura desgastada y abandonada sirve como un recordatorio de las actividades marítimas que una vez prosperaron en ese lugar. A pesar del declive de la navegación y la transformación del área circundante, es importante reconocer el papel histórico desempeñado por el astillero Arataca. A lo largo de los años, fue testigo de la construcción y reparación de numerosas embarcaciones, contribuyendo al desarrollo económico y cultural de la región. Aunque su condición actual es la de una ruina, reconocemos el valor patrimonial de dicho astillero en el contexto de un paisaje histórico de la producción (SOBRINO SIMAL, 2006) y, por lo tanto, abogamos por esfuerzos para su rehabilitación como una forma de valorar los rasgos culturales que componen una parte del importante legado marítimo-industrial de Florianópolis. En este sentido, proponemos una forma de mapear el espacio y sus usos, que tiene en cuenta el concepto de cliodiversidad (SOBRINO SIMAL, 2010, p. 47). Así, buscamos componer una estratigrafía representativa de este paisaje marítimo industrial a través de nuestros recorridos por el territorio en cuestión. Hacemos la cartografía no sólo de la fisonomía del pasado y presente, sino también algunas capas socioespaciales que conforman

el carácter diacrónico en estes diferentes contextos culturales. Esta posibilidad de construir una perspectiva múltiple sobre la territorialidad es la que permite pensar en un proyecto más adecuado a las cuestiones patrimoniales, en adelante de la época contemporânea, también aprendiendo con la comparación con otros sítios (FIORIN, 2023, p. 88), especialmente dada nuestra creciente responsabilidad con el medio ambiente, la sostenibilidad y una necesaria interrelación de las acciones humanas para mantener la naturaleza.

## 3. EL CAMINAR Y LA ESPACIALIDAD ARQUITECTÓNICA DEL ASTILLERO ARATACA

Bajo el puente colgante restaurado Hercílio Luz, se encuentran las ruinas del Estaleiro Arataca. Ha estado abandonado desde la década de 1990, cuando funcionó una discoteca en su espacio. Debido a una disputa legal que lleva años en curso entre el Estado y el patrimonio familiar de Carl Hoepcke, se encuentra en ruinas, albergando el arte callejero y lo más mundano en la cultura del espacio urbano, y puede ser considerado un lugar marginal en nuestras investigaciones anteriores (FIORIN, 2021).

Estos espacios son desafiantes, ya que rompen con los patrones tradicionales de legibilidad, conformándose por formas fragmentarias y ocupaciones sorprendentes. No son estables ni estabilizadores. Reflejan las discontinuidades e incertidumbres del mundo al imponerse a la duda, como su amalgama constituyente. Justamente por su carácter ambiguo, sus intersticios, residuos y vacíos resignifican los espacios de la ciudad, al establecer un nuevo sistema de comunicación e información urbana que necesita ser decodificado (FERRARA, 2000).

Esta tarea se lleva a cabo a través del caminar como práctica estética (CARERI, 2013). Adoptamos la modalidad peripatética como medio para trazar recorridos alrededor de las ruinas del antiguo astillero, activando la subjetividad de quienes recorren el lugar y son sorprendidos por las sorpresas, llevándolos a una lectura dinámica de las narrativas históricas que puedan generar nuevas perspectivas sobre el territorio. Bajo esta perspectiva singular, fomentamos otras formas de ver la ciudad y sus lugares. En este prisma, el objetivo de la fenomenología es un enfoque científico de la subjetividad. Y, de esta manera, la percepción o el proceso de toma de conciencia del mundo que nos rodea se dirige a la esencia del fenómeno, no a su apariencia. No se trata simplemente de mirar la ruina y constatar su estado de deterioro, sino de ver más allá de lo que se presenta a la vista, superando una hegemonía de la visión.

De esta manera, las especialidades arquitectónicas de las ruinas del Estaleiro Arataca se evidenciaron aquí mediante el encuentro con un mundo experimentado, uno que no sigue las ortodoxias y en el que la memoria, la percepción y la fantasía se fusionan (PALLASMAA, 2018). Una concepción que también implica tener en cuenta las experiencias de nuestras vivencias y valorar un espacio existencial; es decir, aquel que es producto de la interpretación del yo en el lugar, un aprendizaje basado en la profundidad fenomenológica. Esto construye la subjetivación, que nos ayuda en el proceso de diseño.

Por lo tanto, buscamos cartografiar (PASSOS; KASTRUP; ESCÓSSIA, 2009) las dimensiones del proceso de diseño, teniendo en cuenta las cualidades arquitectónicas inherentes a la ruina del astillero en relación con su ocupación única, debajo del puente Hercílio Luz. Esto no solo implica el estudio de imágenes antiguas de lo que solía ser la antigua estructura, sino también la comprensión de las complejidades de un contexto marginal que debe ser experimentado, conceptualizado por los usos y apropiaciones, pero sobre todo comprendido para que el proyecto no tenga un fin en sí mismo. Este procedimiento presenta nuestro caminar a través de los escombros, a través de mapas, capturando detalles con fotografías, delineando las edificaciones, límites y aberturas en cartogramas, como nuestras formas de subjetivar una experiencia del espacio relacionada con la creatividad.

Al buscar esta subjetivación del territorio, nuestra incursión se adentra en la cabecera insular del puente Hercílio Luz, un lugar emblemático en la ciudad. Recorremos los alrededores, avistamos la chimenea del antiguo incinerador de basura y las fábricas de Carl Hoepcke, que recientemente se han revitalizado para convertirse en un nuevo centro comercial y empresarial. Registramos el recorrido en infografías. Superponen mapas y fotografías. Los elementos presentes en el espacio que nos sorprendieron durante el recorrido fueron resaltados, contribuyendo al mapeo del territorio a través del método de la cartografía.

Al caminar por las antiguas ruinas del Estaleiro Arataca, nos intrigaron principalmente los vestigios de actividad humana, lo que demuestra que hay personas utilizando lo que queda del contexto de las antiguas edificaciones marítimo-industriales. Subjetividades subalternas se refugian allí, convirtiendo las construcciones deterioradas existentes en su refugio. Elementos visuales y físicos componen el paisaje de las ruinas, como grafitis en las paredes, residuos de alimentos y objetos de consumo cotidiano. El fuerte olor a orina y heces se mezcla con los restos

de comida y expone la marca de los usos marginales. El lenguaje en los grafitis y pintadas presentes allí denota un tono de protesta de quienes viven exiliados del mundo capitalista. Expresan críticas y palabras de lucha, lo que convierte al lugar en un espacio que va en contra de la cultura del poder hegemónico. Las ruinas también revelan un espacio libertario y de libertinaje, que surge del carácter transgresor del espacio.

Los elementos estructurales de las ruinas del Estaleiro que aún permanecen en pie son: un antiguo taller, sede de administración y la pequeña casa de los trabajadores de Arataca. En el terreno, estos edificios ocupan un espacio considerablemente menor que las antiguas edificaciones que conformaban todo el complejo. Sin embargo, de este conjunto solo quedan algunas losas de piso y algunos muros de contención, además de las rampas para la reparación de barcos.

**Figura 02:** Mapa del Paisaje Histórico de la Producción Marítimo-Industrial y Cuadrícula de Fotos de la Espacialidad Arquitectónica del Astillero Arataca

**Fuente:** Autores, Grupo de Pesquisa P4, 2023.

La antigua sede del astillero está parcialmente expuesta a los elementos. Tiene dos pisos. El piso superior fue el más degradado por la demolición que ocurrió hace años, precisamente para evitar usos marginales por parte de las autoridades públicas. Sus ruinas están cubiertas de vegetación. Las paredes que conforman la fachada principal tuvieron sus ventanas arrancadas, creando aberturas en la fachada que mira al mar y hacia la avenida que pasa debajo del puente Hercílio Luz. Estas aberturas funcionan como puertas para albergar usos transgresores o aquellos que se esconden allí. La pequeña residencia es la que se encuentra mejor conservada. Todas las paredes de las habitaciones y partes de la cubierta y el piso están en buen estado. Las aberturas aún mantienen algunos marcos de las antiguas ventanas de madera. Debido a que está parcialmente cubierta, tanto por el techo original como por la vegetación, es en esta casita donde encontramos más registros de la vivencia de subjetividades subalternas.

El gran graffiti de un camaleón es lo que define el espacio. Lo interpretamos aquí como una metalingüística de su ocupación a lo largo del tiempo. La capacidad transformadora que puede dar espacio a un proyecto abierto a la invención. De esta manera, las ruinas revelan una condensación de los fenómenos urbanos en su propia estructura a lo largo del tiempo. La apropiación de este espacio y sus intervenciones humanas contrastan con el deseo de conformar la ciudad de manera ordenada a través de puentes y rellenos, destacando precisamente las muchas desigualdades de una sociedad segregadora. Los cartogramas del astillero y sus alrededores marítimo-industriales generan una perspectiva de esta espacialidad arquitectónica en un proceso de reconocimiento cognitivo-proyectual del lugar marginal. La interferencia en este contexto debe evitar al máximo eliminar usos imprevistos, abriendo puertas a su imprevisibilidad.

**Figura 03:** Cartograma del Astillero Arataca y de las Ruinas del Astillero

**Fuente:** Autores, Grupo de Pesquisa P4, 2023

**Figura 04:** Cartograma de las Ruinas del Astillero Arataca, Planos, Cortes y Elevaciones

**Fuente:** Autores, Grupo de Pesquisa P4, 2023.

## 4. EL DIAGNÓSTICO DE LAS MANIFESTACIONES PATALÓGICAS DEL ESTALEIRO ARATACA

El diagnóstico de las manifestaciones patológicas en el Estaleiro Arataca, ubicado en el centro expandido de Florianópolis, es un procedimiento fundamental para identificar y evaluar las condiciones de estas estructuras abandonadas. Se llevó a cabo a través de un relevamiento y análisis in situ, así como la recopilación de información, con el propósito de comprender la naturaleza y el origen de las patologías existentes, buscando definir las mejores formas de tratamiento y mantenimiento necesarias para corregir estas imperfecciones.

Las edificaciones requieren mantenimientos periódicos para asegurar su integridad y vida útil, ya que los materiales con los que están construidas pueden sufrir degradación a lo largo del tiempo debido a la exposición a agentes ambientales adversos (RODRIGUES; NORA & FIORIN, 2023). Según señala, el mantenimiento de la calidad en todas las etapas del proceso constructivo, desde la planificación y el diseño hasta la elección de materiales, la ejecución de la obra y el uso del edificio, es crucial para garantizar la durabilidad de una construcción. Sin embargo, Anoni y Rodrigues (2022) definen que los errores durante la ejecución de las construcciones son la principal causa de las manifestaciones patológicas, seguidos por problemas en el diseño y uso inadecuado de los edificios, como es el caso de estas ruinas que estamos analizando.

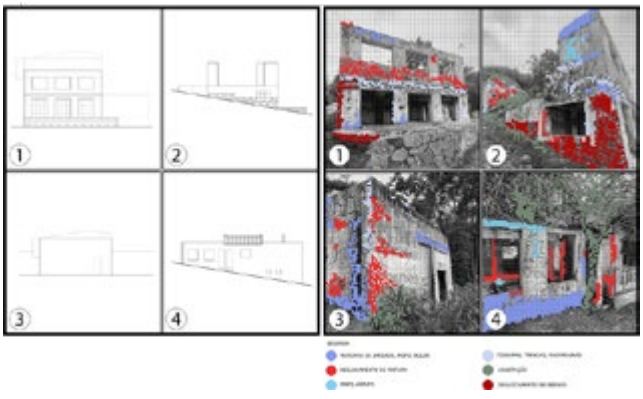

**Figura 05:** Cartograma de las Patologías Constructivas de las Ruinas del Astillero Arataca

**Fuente:** Autores, Grupo de Pesquisa P4, 2023.

Durante las visitas técnicas, los profesionales responsables del diagnóstico evaluaron diversos aspectos de las edificaciones, como el historial de uso, la calidad de la construcción y las condiciones de conservación. Además, se realizó un análisis detallado de las manifestaciones patológicas presentes, como grietas, fisuras, infiltraciones, entre otras, que fueron documentadas con fotografías. Este análisis fue esencial para la elaboración de planes de mantenimiento y conservación de las estructuras abandonadas en el Estaleiro Arataca.

En este sentido, a través de este trabajo fue posible identificar las causas de las manifestaciones patológicas, evaluar los daños y definir las intervenciones necesarias para recuperar la edificación. Este trabajo debe incluir desde medidas preventivas, como la impermeabilización de paredes, hasta nuevas acciones correctivas, como la recomposición de fachadas y estructuras afectadas por infiltraciones. De esta manera, una alternativa accesible y ecológicamente viable para rehabilitar el Estaleiro Arataca también implica la incorporación de una serie de medidas que detallamos a continuación, que van desde el uso de materiales sostenibles hasta un plan de gestión de residuos:

Incorporación de materiales reciclados: utilizar ladrillos y piedras existentes en el propio lugar o de demoliciones para recuperar fragmentos faltantes en las ruinas, reduciendo costos y promoviendo la sostenibilidad ambiental.

Implementación de técnicas constructivas más eficientes para el proyecto de intervención, como la construcción modular, que puede disminuir costos y acortar el tiempo de obra cuando sea necesario.

Integración de fuentes energéticas renovables: la instalación de paneles solares u otras fuentes de energía renovable puede reducir los gastos energéticos a lo largo del tiempo y optimizar la eficiencia energética de las nuevas instalaciones del astillero.

Utilización de sistemas hídricos sostenibles: implementar sistemas de recolección de agua de lluvia y sistemas de riego puede reducir el consumo de agua y ayudar en el mantenimiento de la vegetación alrededor del astillero.

Adopción de un plan de gestión de residuos: la implementación de un plan para la gestión de residuos garantizará el tratamiento responsable y sostenible de los residuos generados durante el proceso de rehabilitación.

## 5. EL PATRIMONIO CONTEMPORÁNEO

En un momento en que las configuraciones urbanas contemporáneas se orquestan cada vez más para construir el espectáculo urbano, los movimientos municipales y empresariales para la renovación de zonas deterioradas, la atracción de turistas y las inversiones están ganando más fuerza. Sin embargo, las imposiciones espaciales que resultan de estos esfuerzos solo han reforzado el

carácter fragmentado de la ciudad y la han distanciado cada vez más de los compromisos con la calidad de vida de las comunidades. En este sentido, muchos proyectos de renovación tienden a higienizar edificios antiguos en una acción de limpieza de las capas yuxtapuestas de tiempo, prácticas y usos que los hicieron existir, cubriendo las fachadas con pintura, con el fin de borrar su historia. Estas actuaciones apuntan exclusivamente a la rentabilidad del patrimonio arquitectónico cultural (ARANTES et. al., 2002, p. 31).

Por el contrario, proponemos aquí innovar en el ámbito del patrimônio, el paisaje y la economía creativa, para que puedan dialogar entre sí, incrementar el turismo con las nuevas tecnologias, generando contribuciones y mantenendo los Otros.

Mirando al pasado, queremos construir un hilo conductor que tenga algún sentido en la apropiación del patrimonio maritima-industrial en decadencia, a favor de la idea de utilizar algunos de estos edificios para implementar zonas de reinvención.

En la experiencia vivida en Florianópolis, observamos cuántos espacios urbanos centrales pueden leerse desde la perspectiva del deterioro. El diagnóstico de las manifestaciones patológicas en el Estaleiro Arataca és importante para hacer un cambio de sentido en este espacio. En lugar de intentar ajustar esta imagen destructiva a las narrativas hegemónicas de "revitalización" del patrimonio, deseamos rehabitar la ruina. Esto significa intentar comprender la ruina como resistencia (FREITAS & FIORIN, 2023, p. 249), pero, también, asumir este espacio como un locus que está en incesante proceso de transformación.

Por ello, nos interesa la idea de reinventar la obra construida; precisamente, porque contiene el sentido más plural de la cultura del espacio. Como resultado, lo que anteriormente retrataba los modos de producción marítimo-industrial de la ciudad ahora puede revelar un uso más contemporáneo. De la era de la industria naval, a la era de la fabricación digital. En este sentido, los restos del Astillero de Arataca resultan poderosos espacios de experimentación, a partir de la postal del puente Hercílio Luz.

En este sentido, proponemos aquí pensar en antiguos espacios industriales, con el fin de adaptarlos para la creación de un proyecto arquitectónico que pueda ser un prototipo para futuros espacios de creación, tomando como ejemplo, la constitución de un Laboratorio de Fabricación Digital.

Fab Lab es un término inglés para laboratorio de fabricación. Se trata de espacios que se organizan en una red global y cuentan con una serie de equipamientos destinados, especialmente, a la fabricación 3D y pretenden ser espacios abiertos a todo el mundo y centrados en la idea del "hazlo tú mismo" (NEVES; EICHENNE, 2013, pág.09).

Buscamos guiar la implementación de uno de estos espacios creativos, a través de la creación de un proyecto de prototipo arquitectónico, que aproveche edificios antiguos de la era marítimo-industrial, como ejemplo del Astillero Arataca para construir nuevos espacios para la era digital. Sin embargo, esta investigación no implica equipar um nuevo laboratorio, sino plantear, analizar y proponer una forma de gestión integrada del patrimonio industrial, que pueda resultar en una propuesta de diseño, que tenga en cuenta una vocación cultural, económica y turística. Capaz de recuperar un edificio con valor patrimonial, buscando combinar el paisaje histórico de la producción en la ciudad de Florianópolis con el momento actual de desarrollo tecnológico sostenible.

## 6. EL PROYETO ABIERTO A LA INVENCIÓN

Un proyecto que va en contra de la cultura hegemónica debe ser desafiante. El diseñador debe abandonar su posición dominante, dejando atrás las certezas pasadas en favor de la duda. No debe proponer una restauración, sino el mantenimiento de la ruina. El carácter libertario y de libertinaje surge precisamente de esto. Debe prever que sus paredes serán blanco de grafitis y pintadas, ya que estas son las marcas de la vida urbana. El gran camaleón es la tarjeta de presentación para acoger el lenguaje rebelde que establece al patrimonio marítimo industrial como su nuevo hogar, bajo el puente Hercílio Luz. En este contexto, un proyecto debe conciliar la experiencia subjetiva y la técnica para albergar la historia y las muchas voces diversas que versan sobre el refugio de las subjetividades subalternas en este territorio alternativo. Así, la metamorfosis y el camuflaje pueden ser las insignias conceptuales de la cultura de este espacio.

El significado metamórfico está implícito en el proyecto, que se transforma con el tiempo. La imagen furtiva, que preserva los cimientos de la ruina, permite albergar al Otro. Un lugar que puede vivir con tiempos cambiantes y la ocupación indefinida. Una transformación que es producto de la obsolescencia de las actividades marítimo-industriales y que le dio sentido a un espacio transgresor que se anida dentro. Por esta razón, nuestra posición en el proyecto de rehabilitación fue mantener el piso inferior de la sede como está. Instalamos en él puertas pivotantes con rejillas de metal anodizado, que permiten la

iluminación y la ventilación, evitando la corrosión causada por la brisa marina. El piso superior recibirá una cubierta de metal con vidrio armado intercalado. Reemplazará el antiguo techo, formando un amplio patio bajo la sombra del puente y bajo la luz del sol, para eventos sorprendentes. Una gran caja negra modular con ruedas albergará equipos multimedia, utilizados como plataforma de creación. Un laboratorio nómada destinado al arte callejero. Un taller de la era digital en la antigua ruina de la época industrial. La pequeña vivienda seguirá siendo un hogar. Recibirá un nuevo techo de placas fotovoltaicas con sistema de captación de agua de lluvia y albergará a personas más vulnerables. Todo el conjunto se repara con materiales reciclados y tendrá un plan de gestión de residuos. Una concepción muy importante para mantener las formas limpias de la construcción.

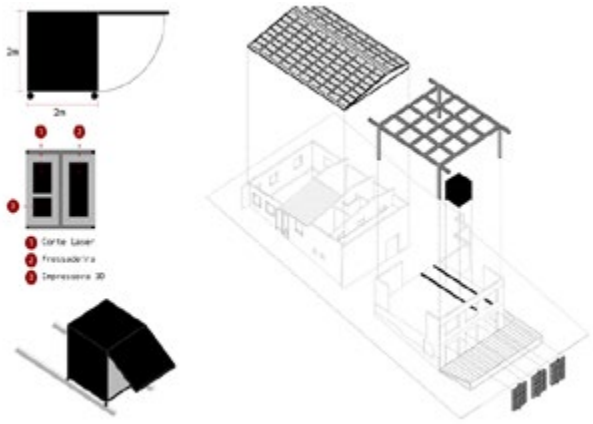

**Figura 06:** Cartograma del Proyecto de las Ruinas del Astillero Arataca
**Fuente:** Autores, Grupo de Pesquisa P4, 2023.

## 7. CONCLUSIONES

La degradación del Estaleiro Arataca es perentoria y evidencia la necesidad de intervenciones destinadas a su rehabilitación. La selección de materiales accesibles y ecológicamente conscientes tiene el potencial de reducir costos, pero también contribuir a la protección del medio ambiente, ante el empeoramiento de la cuestión climática. Además, la implementación de soluciones innovadoras, como la incorporación de sistemas de captación de energía solar para suplir las demandas energéticas de las edificaciones, tendría el efecto de mitigar los gastos, al mismo tiempo que haría que las nuevas estructuras estuvieran más alineadas con los principios de sostenibilidad. La opción de intervenir mínimamente en los espacios, de manera de preservar características y permitir ocupaciones más singulares, también fue considerada. De esta manera, hemos compuesto un conjunto capaz de operacionalizar las diversas iniciativas, sin dejar de lado los usos actuales identificados en el recorrido y cartografía.

En este sentido, es crucial prestar atención al valor que estas construcciones tienen para la ciudad y sus habitantes. La rehabilitación del Estaleiro Arataca trae a la luz un paisaje histórico de la producción y, por lo tanto, debe alinearse con las necesidades de las personas que deambulan por allí, dándole un nuevo eco a una reconciliación de la historia con la humanidad de los espacios de la ciudad contemporánea. Por lo tanto, la conservación del patrimonio industrial desempeña un papel fundamental en el mantenimiento de la identidad de la ciudad y en el reconocimiento de una trayectoria que es dinámica y evolutiva. Un proyecto alternativo lee este proceso y respalda usos inusuales, lo que puede resultar en beneficios sociales, en vista de las subjetividades subalternas que ocupan estas estructuras abandonadas, abriendo espacios para dar refugio a un proyecto inconcluso para una ciudad inacabada (FIORIN; LUCIO & FALLER, 2023). Una propuesta proyectual que es posible de mirar en un videoclip, porque intentamos hacer ilustraciones en movimiento, nel ritmo de los eventos históricos que estudiamos a lo largo de esta investigación. Esta és también una outra manera de fabricación de información y difusión digital, por medio del youtube.

Es necesario abordar el Estaleiro Arataca no solo como un desafío, sino también como una oportunidad para crear un lugar urbano más sensible a estas cuestiones. Un proyecto que esté abierto a la invención no excluye de la dimensión cultural la cuestión social que está implícita en estas ruinas. En resumen, la rehabilitación del Estaleiro Arataca constituye una acción que exige soluciones sostenibles y creativas, que permitan actividades atentas a la era digital, pero también a aquellas personas en situación de vulnerabilidad social. Por lo tanto, requiere una concepción cuyo enfoque experimental otorgue importancia para valorar la dimensión histórica, cultural y social de estas edificaciones en el actual estado de deterioro. Creemos que intervenciones adecuadas en estas ruinas no solo traerán otro significado a ellas en Florianópolis, sino también una memoria plural, más atenta al pasado y presente de la comunidad local.

Desde este punto de vista, la concepción del proyecto prototipo de un antiguo edificio del período marítimo-industrial en la Gran Florianópolis implica la adopción de un programa de la era digital, como vínculo entre pasado y presente. Prevé un sentido multicultural que debe contemplar un espacio, pero, sobre todo, busca indicar que

debemos respetar la diversidad para construir una historia futura más sostenible, en todos los aspectos.

## REFERENCIAS

ANONI, L. G.; RODRIGUES, M. R. P. **Manual de diagnóstico de manifestações patológicas em pequenas construções. Instituto Federal de Educação**, Ciência e Tecnologia de São Paulo de Votuporanga, 2022.

ARANTES, O. B. F.; MARICATO, E. VAINER, A. **A Cidade do Pensamento Único**. São Paulo: Vozes, 2002.

CARERI, F. Walkscapes: **o caminhar como prática estética.** São Paulo: G. Gili, 2013.

FERRARA, L. D. **Significados urbanos.** São Paulo: Edusp, 2000.

FIORIN, E. **Florianópolis: under the bridge, over the hill and on the wall: among graffiti and marginal places.** Oculum Ensaios, [S. l.], v. 18, p. 1–20, 2021. DOI: 10.24220/2318-0919v18e2021a4807. Disponível em: https://periodicos.puc-campinas.edu.br/oculum/article/view/4807. Acesso em: 25 jun. 2023.

FIORIN, E. Paisagens da Produção: Sevilha e Santa Catarina – Do Arenal a Arataca. In: SIMAL, V. J. S. et. al. (orgs). **Nuestro Norte és el Sur:** Revisiones Patrimoniales. Bauru-São Paulo, Sevilla: UNESP / Asociación de Património Industrial de Andalucía Fabricando El Sur, 2023, pp. 88-104. Disponível em: http://hdl.handle.net/11449/250545 Acesso em: 30 de nov. 2023.

FIORIN, E. LUCIO, L. V. FALLER, M. C. C. Projeto Inconcluso para uma Cidade Inacabada. **33º Seminário de Iniciação Científica.** Florianópolis: UFSC, 2023. Disponível em: https://repositorio.ufsc.br/handle/123456789/250199 Acesso em 30 nov. 2023.

FREITAS, D.; FIORIN, E. A Ruína como Resistência em Florianópolis. **Revista Pixo,** v. 24, p. 248-261, 2023. Disponível em: https://revistas.ufpel.edu.br/index.php/pixo/article/view/3960 . Acesso em 30 nov. 2023.

NEVES, H.; EICHENNE, F. **Fab Lab**: a vanguarda da nova revolução. São Paulo: Fab Lab Brasil, 2013.

PALLASMAA, J. **Essências.** São Paulo, Gustavo Gili, 2018.

PASSOS, E. KASTRUP, V.; ESCÓSSIA, L. **Pistas do Método da Cartografia: Pesquisa-Intervenção e produção de subjetividade.** Porto Alegre: Sulina, 2009.

PERES, R. M. **Levantamento e identificação de manifestações patológicas em prédio histórico - um estudo de caso.** Orientador: Dr. Ing. Hélio Adão Greven. 2001. Dissertação (Mestrado em Engenharia) - Escola de Engenharia, Universidade Federal do Rio Grande do Sul, [S. l.], 2001. Disponível em: https://www.lume.ufrgs.br/handle/10183/1582. Acesso em: 8 Agosto. 2023.

REIS, S. R. P. dos. **Carl Hoepcke: a marca de um pioneiro**. Florianópolis: Insular, 1999.

RODRIGUES, M. R. P.; NORA, L. R.; FIORIN, E. Intervenções Temporárias em Ruínas Históricas: uma solução sustentável em Florianópolis-SC. **Revista Jatobá**, v. 5, 2023. https://revistas.ufg.br/revjat/article/view/76519 Acesso em 15 nov. 2023.

SOBRINO SIMAL, J. **Las fábricas del sur. Espacio, memoria y lugar, en Patrimonio Industrial de Andalucía.** Portfolio Fotográfico. Sevilla: Consejería de Obras Públicas y Transportes, 2006.

SOBRINO SIMAL, J. **Los paisajes históricos de la producción en Sevilla.** Sevilla: Instituto Andaluz del Património Histórico, 2010.

VAZ, N. P. **O Centro Histórico de Florianópolis.** Florianópolis: UFSC, 1991.

VEIGA, E. V. **Transporte Coletivo em Florianópolis: origens e destinos de uma cidade à beira-mar.** Florianópolis: Insular, 2004.

VEIGA, E. V. **Florianópolis: memória urbana.** Florianópolis: Fundação Franklin Cascaes, 2010.

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EF: conceptualización, curación de datos, análisis formal, adquisición de financiamiento, investigación, metodología, administración de proyectos, programas, supervisión, validación, visualización, redacción - borrador original, redacción - revisión y edición.

MR: curación de datos, análisis formal, investigación, programas, validación, visualización, redacción - revisión y edición.

EL: análisis formal, administración de proyectos, programas, supervisión, validación, redacción - revisión y edición.
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# SYSTEMATIC BIBLIOGRAPHICAL REVIEW AND GUIDELINES ON ADDITIVE MANUFACTURING/3D PRINTING ORIENTED TO SUSTAINABILITY

## *REVISÃO BIBLIOGRÁFICA SISTEMÁTICA E DIRETRIZES SOBRE MANUFATURA ADITIVA/IMPRESSÃO 3D ORIENTADA À SUSTENTABILIDADE*

## *REVISIÓN SISTEMÁTICA DE LA LITERATURA Y DIRECTRICES SOBRE FABRICACIÓN ADITIVA/IMPRESIÓN 3D ORIENTADA A LA SOSTENIBILIDAD*

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**ABSTRACT**

Due to the technologies diversity on the rise nowadays, it is becomes necessary to investigate how to use them in sustainable practices. The present study is a Systematic Bibliographic Review (SBR) that verified how Additive Manufacturing/3D Printing technology is being associated with sustainability in scientific productions in Brazil. The sixteen (16) selected papers were published in Encontro de Sustentabilidade em Projeto (ENSUS), Congresso Brasileiro de Pesquisa e Desenvolvimento em Design (P&D Design), Simpósio de Design Sustentável (SDS) annals and Mix Sustentável magazine, between the years 2018 to 2023. The results show (1) papers analysis, aiming to identify its central themes, most recurrent were: Product-Service System (PSS), Waste Reduction, Ecodesign and Recycling; (2) Keywords definition, most used being "3D Printing", "Additive Manufacturing", "Biomimicry", "Filaments" and "Recycling"; (3) understanding studies focus through Design for Sustainability strategies; (4) guidelines for applying 3D printing sustainably.

**KEYWORDS**

Additive Manufacturing; 3D Printing; Sustainability; Systematic Bibliographic Review.

***RESUMO***

*Com a diversidade de tecnologias em ascensão na atualidade, torna-se necessário investigar como utilizá-las em práticas sustentáveis. O presente trabalho trata-se de uma Revisão Bibliográfica Sistemática (RBS) que verificou como a tecnologia de Manufatura Aditiva/Impressão 3D está sendo associada à sustentabilidade em produções científicas no Brasil. Os dezesseis (16) artigos selecionados foram publicados em anais do Encontro de Sustentabilidade em Projeto (ENSUS), Congresso Brasileiro de Pesquisa e Desenvolvimento em Design (P&D Design), Simpósio de Design Sustentável (SDS) e na Revista Mix Sustentável, entre os anos de 2018 e 2023. Os resultados apresentam (1) análise do artigo, objetivando identificar seus temas centrais, os mais recorrentes foram: Sistema Produto-Serviço (PSS), Redução de Resíduos, Ecodesign e Reciclagem; (2) definição de palavras-chave, sendo as mais utilizadas "Impressão 3D", "Manufatura Aditiva", "Biomimética", "Filamentos" e "Reciclagem"; (3) compreensão do foco dos trabalhos mediante estratégias do Design para a Sustentabilidade; (4) diretrizes para aplicar a impressão 3D de modo sustentável.*



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## *PALAVRAS-CHAVE*

*Manufatura Aditiva; Impressão 3D; Sustentabilidade; Revisão Bibliográfica Sistemática.*

## *RESUMEN*

*Con la diversidad de tecnologías en auge hoy en día, es necesario investigar cómo utilizarlas en prácticas sostenibles. Este trabajo es una Revisión Bibliográfica Sistemática (RBS) que investigó cómo la tecnología de Fabricación Aditiva/Impresión 3D está siendo asociada a la sustentabilidad en producciones científicas en Brasil. Los dieciséis (16) artículos seleccionados fueron publicados en los anales del Encontro de Sustentabilidade em Projeto (ENSUS), del Congresso Brasileiro de Pesquisa e Desenvolvimento em Design (P&D Design), del Simpósio de Design Sustentável (SDS) y de la Revista Mix Sustentável, entre 2018 y 2023. Los resultados muestran (1) análisis de los artículos, con el objetivo de identificar sus temas centrales, siendo los más recurrentes: Sistema Producto-Servicio (PSS), Reducción de Residuos, Ecodiseño y Reciclaje; (2) una definición de palabras clave, siendo las más utilizadas "Impresión 3D", "Fabricación Aditiva", "Biomimética", "Filamentos" y "Reciclaje"; (3) una comprensión del enfoque de los trabajos a través de estrategias de Diseño para la Sostenibilidad; (4) directrices para aplicar la impresión 3D de forma sostenible.*

## *PALABRAS CLAVE*

*Fabricación Aditiva; Impresión 3D; Sostenibilidad; Revisión Sistemática de la Literatura.*

## 1. INTRODUCTION

In a world with increasingly evident social and environmental problems, affecting the relationship between the environment, human beings and other species, it is essential to turn attention to actions linked to sustainability, reevaluating forms of production and consumption, in an attempt to minimize negative impacts.

In the production and consumption model adopted, mainly since Industrial Revolution in 19th century, natural resources waste generates high levels of residue, which in 2018 already reached 1.3 billion tons per year across the planet, including mining, livestock, agriculture, industries, civil construction, demolition and urban solids, and with the depletion of such riches there is a tendency towards scarcity and depletion (Sampaio et al., 2018).

Therefore, manufacturing systems encompass socio-environmental factors and consequences, as they depend on natural resources, such as raw materials, inputs and/or energy, causing, in addition to waste, other health risks (Riul; Silva; Ribeiro, 2011).

Given this context, it is necessary to seek more sustainable standards for both production and consumption, as proposed in the twelfth (12th) Sustainable Development Goal of United Nations (2015), which is possible by strengthening scientific and technological capabilities.

Regarding technologies related to production processes, 3D Printing, an Additive Manufacturing system in which material is gradually added in several layers to make a physical object based on a digital model (Morandini; Del Vechio, 2020), emerges as an alternative that can be aligned with strategies in line with environmental requirements, such as reducing the use of materials and electrical energy (Manzini; Vezzoli, 2002).

The aforementioned manufacturing method also fits into the trends of bringing people and things together, reducing the need for transportation, and sharing instruments and equipment, avoiding excess products (Manzini, 2008).

Recognizing that the technology in question has a promising character in the field of sustainability and to encourage research uniting these themes, this study seeks to investigate, with the aim of exposing guidelines for practice: how Additive Manufacturing/3D Printing is being linked to sustainability in scientific studies?

## 2. DESIGN AND SUSTAINABILITY

When approaching Design and sustainability, it is essential to understand some relevant concepts. The following topics are sustainable practices in the environmental dimension present in the results of this research, which is why they are used for theoretical basis.

### • ECODESIGN

Ecodesign is characterized by considering the entire life cycle, involving energy, material and spatial impacts, in the development of products, systems, services or infrastructure, directing projects with an interest in eco-efficiency (Platchek, 2012).

To carry out projects based on ecodesign, it is crucial to consider some guidelines, including (Pazmino, 2007):

- Reduce the use of natural and energy resources;
- Use inexhaustible, non-damaging, recycled, recyclable and/or renewable materials;
- Use only one material;
- Reduce weight and volume;
- Minimize production processes;
- Increase safety and durability;
- Eliminate packaging or design it to be recyclable or reusable;
- Facilitate maintenance and repairs;
- Enable the replacement of components or refills.

As fundamental objectives, ecodesign seeks to reduce consequences for the environment, reduce production costs and promote a competitive advantage for companies, in a market in which the appeal for sustainable development grows increasingly, bringing contributions at a global level, due to the capacity to extract raw materials tends to be exhausted quickly (Menezes; Vilaça; Reis, 2010).

### • PRODUCT-SERVICE SYSTEM (PSS)

A Product-Service System (PSS) consists of material products together with intangible services, designed so that together they satisfy the specific needs of users, while also aiming to achieve sustainable goals (Brandstotter et al., 2003).

There are three categories of PSS, each with specific activities, they are (Tukker, 2004):

- Product-oriented services: service related to the product and advice + consultancy;

- Use-oriented services: product rental, rental or sharing of products and product grouping;
- Result-oriented services: management/outsourcing of activities, payment per unit of service and functional results.

The essential aspects of eco-efficient PSS innovations are: support in an economic model that has satisfaction as its focus, meeting specific satisfaction demands, and the basis on the interactions of stakeholders, enabling radical innovations such as new relationships and partnerships within a certain productive network of satisfaction (Vezzoli et al., 2018).

## • WASTE REDUCTION

Waste refers to a vast group of materials discarded by different social agents, generated by the many activities of human beings, such as agriculture, livestock farming, mining, among others (Sampaio et al., 2018).

In general, to reduce such waste it is necessary to change the patterns in which society produces and consumes goods, with actions that include waste control, product reuse and recycling (Ribeiro; Besen, 2007).

This reduction can start with simple actions such as using cloth napkins, not using plastic bags and straws and avoiding food waste, thus contributing to the rationalization of nature's resources (Pozzetti; Caldas, 2019).

In addition to education for responsible consumption, covering all sectors, adequate management of natural capital is essential, an action that needs to be taken and maintained in companies and also in public administration (Figueiredo; Nascimento, 2021).

## • ADDITIVE MANUFACTURING/3D PRINTING

The timeline of 3D Printing begins in the 1980s, with the patent application for a rapid prototyping system by Japanese doctor Hideo Kodama, from Nagoya Municipal Industrial Research Institute. Describing this technology as "a vat of photopolymer material (type of resin), with exposure to UV light, which stiffens the part, producing a certain model in layers" (Figure 1). However, the registration was not successful (Lonjon, 2017).

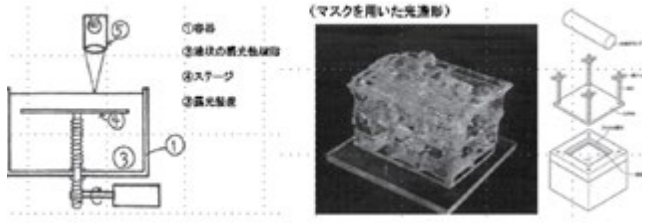

**Figure 1:** Photopolymer material vat with UV light exposure, by Hideo Kodama.
**Source:** Institute of Electronics, Information and Communication Engineers [IEICE] (2014).

3D Printing is a manufacturing process through gradual addition of material in layers, receiving information from a 3D computer representation of the component. The stages of this production means can be listed as follows (Carvalho; Volpato, 2017):

(1) Three-dimensional (3D) modeling;
(2) Conversion of the three-dimensional geometric model to a format suitable for printing;
(3) Slicing and delimiting support structures and techniques for material to be deposited;
(4) Object manufacture on 3D printer;
(5) Post-treatment.

Figure 2 illustrates how this process occurs.

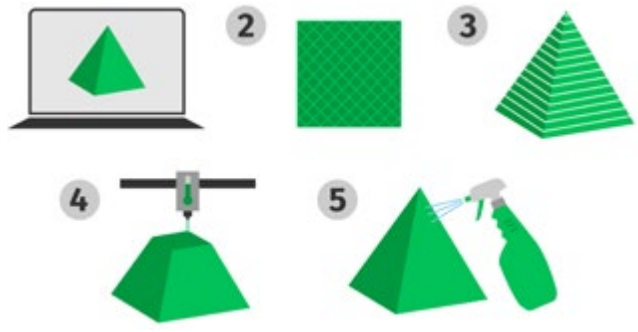


**Figure 2:** 3D printing steps.
**Source:** Authors (2023).

There are several types of Additive Manufacturing technologies and, consequently, 3D Printing techniques, both indicated with their acronyms by the standard "ISO/ASTM 52900-15: Standard Terminology for Additive Manufacturing" (Mousapour, 2020).

3D printing is present in several areas such as Medicine: transplants with personalized structures for each patient; Biology: researchers can study types of fossils or bone structures through copies; History: replicas of value or importance items from other centuries are capable of being

produced; Nutrition: food solutions can be developed in laboratory; Robotics: improvements to mechanical parts and electronic components; Design: designing higher quality prototypes for projects (Erickson, 2012).

Checking so many examples, it is clear how 3D Printing has revolutionized the market and even science on a global level, contributing to the advancement of various segments. In this scenario, it becomes of great relevance to understand it based on sustainable precepts, which are capable of making it less harmful to environment, since sustainable development has been established as a goal for contemporary society and new production processes must be aligned with these objectives.

## • METHODOLOGICAL PROCEDURES

This research can be classified, with regard to its purpose, as pure (Gil, 2008), as it seeks to produce scientific knowledge by investigating the state of art about relation between 3D printing and sustainability, but without claiming real applications and consequences. In a philosophical conception, it can be seen as pragmatic, because it comes from actions consequences and is oriented towards practice in the real world (Creswell, 2010). Its nature is mixed as it includes collection, analysis and integration of qualitative data, referring to papers content, and quantitative, relating to percentages of subjects covered in them (Sampieri, Collado; Lucio, 2013). The research is also characterized, in terms of scope, as descriptive (Gil, 2008), as it reports how interest themes are treated in the academic studies evaluated.

It is defined as a Systematic Bibliographic Review (SBR), a verification model that highlights its steps, making it possible to track the criteria taken into consideration for execution, thus allowing other researchers to be able to replicate it (Santos, 2018).

Figure 3 shows how methodological processes are organized.

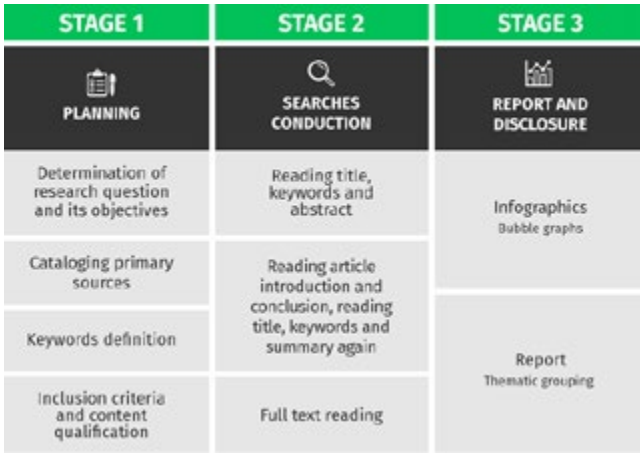


**Figure 3:** Methodological flowchart.

**Source:** Adapted from Santos (2018).

In Phase 1, with research question already defined, presented previously in the introduction topic, the sources for searching for papers were determined, being annals those events/journals: Encontro de Sustentabilidade em Projeto (ENSUS), Mix Sustentável Magazine - from the Federal University of Santa Catarina (UFSC) -, Congresso Brasileiro de Pesquisa e Desenvolvimento em Design (P&D Design) and Simpósio de Design Sustentável (SDS), covering the period from 2018 to 2023. The keywords used were "Impressão 3D" and "Manufatura Aditiva", also in english: "3D Printing" and "Additive Manufacturing", since some sources have studies in that language. The criterion for screening papers was that scope should concern Additive Manufacturing/3D Printing associated with sustainable solutions.

Table 1 presents the systemic survey with amount of publications found and how many were selected, after reading the title, keywords, introduction and conclusion, as described in Phase 2, from each database, as well as papers total number.

**TABLE 1**: Systemic Survey

| Data Base | Publications found | Selected publications in screening |
|---|---|---|
| ENSUS | 13 | 9 |
| MIX SUSTENTÁVEL | 4 | 4 |
| P&D DESIGN | 7 | 2 |
| SIMPÓSIO DE DESIGN SUSTENTÁVEL | 1 | 1 |
| **TOTAL** | **25** | **16** |

**Source:** Authors (2023).

Thirteen (13) papers were found from ENSUS and nine (9) were selected, as the others were also published, with their more complete contents, in magazine included in the review, two (2) of which were from 2019, one (1) from 2020, two (2) in 2021, one (1) in 2022 and three (3) in 2023, in Revista Mix Sustentável four (4), one (1) from 2019, two

(2) from 2021 and one ( 1) from 2023, from P&D Design seven (7), but only two (2) were chosen, following the established criteria, one (1) from 2018 and one (1) from 2022, and in SDS one (1), from 2019.

After reading full studies text, a classification was carried out based on guiding themes of each of them, with respective percentages structured in infographics, following a thematic grouping report, a strategy focused on describing main various themes characteristics, but about a common research problem (Santos, 2018), and development of a framework with guidelines for sustainable practices in the context of 3D printing, as determined in Phase 3. This investigation will be presented in below topic.

## 3. RESULTS AND DISCUSSIONS

With the completion of Planning and Conducting Search phases, an investigation began on the previously selected papers, with intention of recording sustainable themes that were associated with Additive Manufacturing/3D Printing, also based on subjects discussed in theoretical references. The results were divided into databases, publication year, title, authors and central theme(s) (**Chart 1**).

Through this investigation it was noted that there is a trend towards some themes and following what was determined in Phase 3, Report and Disclosure, themes and their quantities were gathered in a bubble chart (Figure 4).


**Figure 4:** Central themes of studies.

**Source:** Authors (2023).

The results indicated Product-Service System as five (5) papers theme, Ecodesign as four (4), Recycling and Waste Reduction as three (3) each and Sustainable Development as only two (2).

In studies centered on Product-Service System, the practices were focused on health and veterinary areas, in manufacture of prostheses, orthoses, among others, and ways of distributing them to users, which may include laboratories, thus offering services. Ecodesign was approached based on products improvement, in aspects such as customization, flexibility, lightness and resistance, and Waste Reduction was mostly linked to civil construction, in cementitious materials design. Recycling was related to creation of filaments derived from waste, such as polymers and wood, and Sustainable Development through residential projects analysis and businesses mapping that include 3D printing in the scope of their service provision. The keywords of papers were also investigated, considering their frequency (Figure 5).

Among 44 terms, the most recurrent were "3D Printing", appearing nine (9) times, "Additive Manufacturing" three

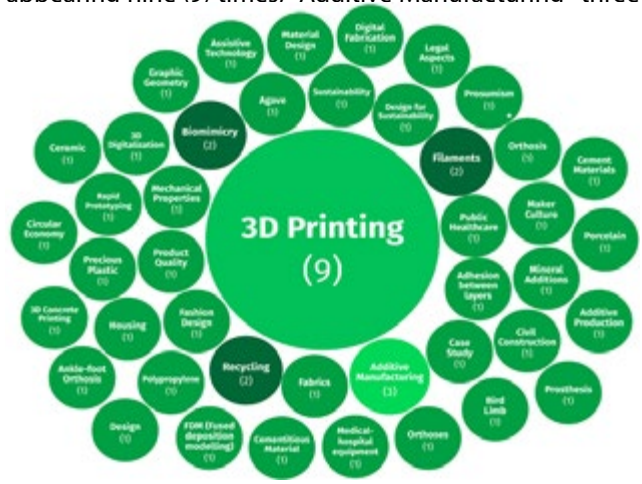


**Figure 5:** Keywords of studies.

**Source:** Authors (2023).

(3), "Biomimetics", "Filaments" and "Recycling" two (2) each. There are only one (1): "3D Concrete Printing", "3D Digitization", "Additive Manufacturing", "Adhesion Between Layers", "Agave", "Ankle-Foot Orthosis", "Assistive Technology", "Bird Limb", "Case Study", "Cementitious Material", "Cementitious Materials", "Ceramics", "Circular Economy", "Civil Construction", "Design", "Design for Sustainability", "Digital Manufacturing", "Fabrics", "Fashion Design", "FDM (Fused Deposition Modelling)", "Graphic Geometry", "Housing", "Legal Aspects", "Maker Culture", "Material Design", "Mechanical Properties", "Medical-hospital Equipment", "Mineral Additions", "Ortheses", "Orthesis", "Polypropylene", "Porcelain", "Precious Plastic", "Product Quality", "Prosthetics", "Prosumism", "Public Healthcare", "Rapid Prototyping" and "Sustainability".

Finally, it was found out what studies resulted in/focused

| Data Base | Publications year | Title | Authors | Central theme(s) |
|---|---|---|---|---|
| ENSUS | 2019 | Prótese de membros em pássaros: estudo de caso de aplicação da Biomimética e impressão 3D | Rayane França Paes Queiroz, Cynara Fiedler Bremer e Fernando José da Silva | Product-Service System (PSS) |
| | | Da Representação Gráfica 3D à Fabricação Aditiva de Cerâmicos Industriais de Forma Complexa | José Manuel C. B. C. Frade e Josiane Wanderlinde Vieira | Ecodesign |
| | 2020 | Uma Revisão Sistemática da Literatura sobre os Processos de Design direcionados a Manufatura Aditiva em Fab Labs para melhoria da qualidade do produto e redução de resíduos | José Ignacio Sánchez e Germannya D`Garcia Araújo Silva | Ecodesign + Waste Reduction |
| | 2021 | Utilização de cinza volante (CV) para impressão 3D | Lívia Fernanda Silva, Gustavo de Pinho Tavares Filla, Ester Meira Ramos Amorim, Monique de Brito Filgueiras e Berenice Martins Toralles | Waste Reduction |
| | | Elementos de concretos produzidos por impressão 3D com foco na aderência entre camadas: uma revisão | Monique de Brito Filgueiras, Lívia Fernanda Silva e Berenice Martins Toralles | Waste Reduction |
| | 2022 | Digitalização 3D e impressão 3D de baixo custo voltada à saúde pública: estudo de aplicação em órtese infantil | Leonardo Teixeira Bortoleto e Claudio Pereira de Sampaio | Product-Service System (PSS) |
| | 2023 | Desenvolvimento de Órtese Pediátrica do Tipo Tornozelo-Pé com uso de Impressão 3D | Herbert Renato Coelho Gomes, Cláudio Pereira de Sampaio, Sônia Maria Fabris e José Antonio Vicentin | Product-Service System (PSS) |
| | | Pesquisa, Desenvolvimento & Fabricação Digital com uso da Impressão 3D: desafios para o desenvolvimento e regulamentação de dispositivos na área da saúde | Sonia Maria Fabris Luiz, José Antônio Vicentin e Cláudio Pereira de Sampaio | Product-Service System (PSS) |
| | | Sustentabilidade e materiais: Viabilidade da produção de filamentos para impressão 3D através da utilização de polipropileno reciclado | Tauana Batistella e André Canal Marques | Recycling |
| MIX SUSTENTÁVEL | 2019 | Investigação de Estratégias de Leveza e Resistência das Fibras de Agave para Material de Impressão 3D Bioinspirado | Amilton José Vieira de Arruda, Emília Cristina Pereira Arruda e Rodrigo Barbosa de Araújo | Ecodesign |
| | 2021 | Estudo da Viabilidade de Fabricação de Filamento Compósito Sustentável para Impressão 3D a partir de uma Matriz PLA Reforçada com Resíduos de Fibras de Madeira | Daniel Lauxen Spohr, Felipe Antônio Lucca Sánchez e André Canal Marques | Recycling |
| | | Design e Impressão 3D na Pandemia: Uma Análise de Possibilidades a partir do Modelo Teórico DFSS | Cláudio Pereira de Sampaio e Sonia Maria Fabris Luiz | Product-Service System (PSS) |
| | 2023 | Impressão 3D com Materiais Cimentícios: Uma Análise Comparativa de Projetos Residenciais | Luana Toralles Carbonari, Berenice Martins Toralles, Lívia Fernanda Silva, Lisiane Ilha Librelotto e Thalita Gorban Ferreira Giglio | Sustainable Development |
| P&D DESIGN | 2018 | Tecido Impresso em 3D para a Indústria do Vestuário | Lais Estefani Hornburg, Carine Rorato de Oliveira, Arlete Ehlert de Souza, Jeferson Daronch e Danilo Corrêa Silva | Ecodesign |
| | 2022 | A impressão de Artefatos 3D como Alavanca Social: o 3DP e o movimento maker no contexto pernambucano | Luiz Valdo A. Maciel, Amilton Arruda e Thamyres Clementino Oliveira | Sustainable Development |
| SIMPÓSIO DE DESIGN SUSTENTÁVEL | 2019 | Plástico Precioso: prototipagem rápida e reciclagem de resíduos de manufatura aditiva | Mario Ruiz Manrique, Leticia Teixeira Mendes, Auta Luciana Laurentino e Sadi da Silva Seabra Filho | Recycling |

**CHART 1**: Systematic Bibliographic Review Detailing

**Source:** Authors (2023).

on, whether product or service (Figure 6).


**Figure 6:** Result/focus of studies.

**Source:** Authors (2023).

It was found that of sixteen (16) studies, fourteen (14) resulted in or focused on product, only one (1) on service and another (1) about the union of product and service. The only study focused on service is "A impressão de Artefatos 3D como Alavanca Social: o 3DP e o movimento maker no contexto pernambucano", by Luiz Valdo A. Maciel, Amilton Arruda and Thamyres Clementino Oliveira, and on product + service: "Design e Impressão 3D na Pandemia: Uma Análise de Possibilidades a partir do Modelo Teórico DFSS", by Cláudio Pereira de Sampaio and Sonia Maria Fabris Luiz.

Based on the cases presented in analyzed studies, some guidelines are proposed for the application of Additive Manufacturing/3D Printing in sustainable projects/businesses, mainly taking into account environmental dimension (**Chart 2**).

**CHART 2**: Guidelines for Additive Manufacturing/3D Printing Sustainable

| How to use Additive Manufacturing/3D Printing in a sustainable way? |
|---|
| 1. Give preference to printing in Fab Labs/Digital Manufacturing Laboratories. |
| 2. Use sustainable [biodegradable or recycled] filaments/liquid resins. |
| 3. Adjust print settings appropriately to avoid wasting material and save energy. |
| 4. Develop products with a minimum of components. |
| 5. Offer replacement parts. |
| 6. Pay attention to expiration date of liquid resins to avoid unnecessary disposal. |
| 7. Enable disused/damaged products collection for recycling. |
| 8. Adopt recycling techniques for leftover materials and discarded products. |
| 9. Correctly dispose of unusable liquid resins, preferably at collection points. |

**Source:** Authors (2023).

## 4. FINAL CONSIDERATIONS

Through the Systematic Bibliographical Review (RBS) carried out, a relevant overview was obtained to understand, and at the same time demonstrate, how Additive Manufacturing/3D Printing is capable of being used for sustainability. It was found that Product-Service System, Ecodesign, Recycling and Waste Reduction were prominent themes and that focus on products is greater in relation to services, taking into account that results prioritized tangible goods.

Other points to highlight are areas variety, such as design, architecture, health, fashion, which include sustainable projects with technology mentioned, and that data obtained highlights gaps to be filled, such as deficit of initiatives based on sustainable development and those that essentially result in service, in addition to low annual scientific production on subjects reviewed, and can contribute as guidelines.

Given this, it can be stated that initial objective, verifying how two areas that supported this review are related, was achieved, taking into account detailing studies scientific selected and information extracted from them.

The main difficulties involved accessing studies in databases whose annals are divided into several platforms and, in some cases, characterizing papers central themes.

For future study, it is suggested that RBS be carried out at other events and periodicals, including outside the Brazilian context, aiming for greater understanding and coverage, and possible updates to proposed guidelines.

## REFERENCES

BRANDSTOTTER, M., HABERL, M., KNOTH, R., KOPACEK, B., KOPACEK, P. IT on demand - towards an environmental conscious service system for Vienna (AT). In: Proceedings of EcoDesign'03: Third International Symposium on Environmentally Conscious Design and inverse Manufacturing, 2003, Japão. **Anais**… Japão: 2003, p. 799-802.

CARVALHO, Jonas de; VOLPATO, Neri. Introdução à manufatura aditiva ou impressão 3D. In: **Manufatura aditiva**: tecnologias e aplicações da impressão 3D. São Paulo: Blucher, 2017.

CRESWELL, John Ward. **Projeto de pesquisa**: métodos qualitativo, quantitativo e misto. 3. ed. Porto Alegre: Artmed, 2010.

ERICKSON, Christine. **9 ways 3D printing can change the world**. Mashable, 26 fev. 2012. Disponível em: https://bit.ly/36gwT3f. Acesso em: 15 mai. 2023.

FIGUEIREDO, Elisabeth de Almeida; NASCIMENTO, Lucio Fabio Cassiano. Resíduos sólidos e a responsabilidade ambiental / Solid waste and environmental responsibility. **Brazilian Journal Of Development, Curitiba**, v. 7, n. 12, p. 114642-114659, 29 dez. 2021. South Florida Publishing LLC. http://dx.doi.org/10.34117/bjdv7n12-301.

GIL, Antonio Carlos. **Métodos e Técnicas de Pesquisa Social**. 6. ed. São Paulo: Editora Atlas, 2008.

LONJON, Capucine. **The history of 3d printer: from rapid prototyping to additive fabrication**. Sculpteo, 1 mar. 2017. Disponível em: https://bit.ly/2XdHhER. Acesso em: 05 mai. 2023.

MANZINI, Ezio. **Design para a inovação social e sustentabilidade**: comunidades criativas, organizações colaborativas e novas redes projetuais. Caderno do Grupo de Altos Estudos. Programa de Engenharia de Produção da Coppe/UFRJ. Rio de Janeiro: E-papers Serviços Editoriais Ltda, v. 1, 2008.

MANZINI, Ezio; VEZZOLI, Carlo. **O desenvolvimento de produtos sustentáveis**: os requisitos ambientais dos produtos industriais. São Paulo: EDUSP, 2002. 366 p.

MENEZES, Monica D.; VILAÇA, Paula C.; REIS, Luciana P. Technology roadmapping (TRM) no contexto do ecodesign: um estudo de caso da madeira plástica. In: XXX Encontro Nacional de Engenharia de Produção, 2010, São Paulo. **Anais**… São Paulo: ABEPRO, 2010, p. 1-13.

MORANDINI, Moisés Miranda; DEL VECHIO, Gustavo Henrique. IMPRESSÃO 3D, TIPOS E POSSIBILIDADES: uma revisão de suas características, processos, usos e tendências. **Revista Interface Tecnológica**, Taquaritinga, v. 17, n. 2, p. 67-77, 18 dez. 2020.

MOUSAPOUR, Mehrdad. **Multi-metal 3D printing with extrusion method**. 2020. 105 p. Dissertação (Mestrado) – Degree program Chemical, Biochemical and Materials Engineering, School of Engineering, Aalto University, Espoo, 2020.

ORGANIZAÇÃO DAS NAÇÕES UNIDAS (ONU). **Os Objetivos de Desenvolvimento Sustentável no Brasil**. 2015. Disponível em: https://brasil.un.org/pt-br. Acesso em: 28 jun. 2023.

PAZMINO, Ana Verónica. **Uma reflexão sobre Design Social, Eco Design e Design Sustentável**. Curitiba: I Simpósio Brasileiro de Design Sustentável, 2007.

PLATCHECK, Elizabeth Regina. **Design Industrial**: metodologia de ecodesign para o desenvolvimento de produtos sustentáveis. São Paulo: Atlas, 2012.

POZZETTI, Valmir César; CALDAS, Jeferson Nepumuceno. O descarte de resíduos sólidos no âmago da sustentabilidade. **Revista de Direito Econômico e Socioambiental**, Curitiba, v. 10, n. 1, p. 183-205, jan./abr. 2019. doi: 10.7213/rev.dir.econ.soc.v10i1.24021.

RIBEIRO, Helena; BESEN, Gina Rizpah. Panorama da coleta seletiva no Brasil – desafios e perspectivas a partir de 3 estudos de caso. **Revista InterfacHES**, n. 4. 2007.

RIUL, Marília.; SILVA, Lilian Ferreira Cardoso da; RIBEIRO, Edson Leite. Aspectos e Impactos Sociais e Ambientais da Indústria Moveleira e Experiências de Gestão. **Revista Principia - Divulgação Científica e Tecnológica do IFPB**, João Pessoa, n. 18, 2011. p.79-95.

SAMPAIO, Cláudio P. de; SANTOS, Aguinaldo dos; LOPES, Camila S. D.; TREIN, Fabiano A.; CHAVES, Liliane L.; LIBRELOTTO, Lisiane L.; FERROLI, Paulo Cesar M.; LEPRE, Priscilla R.; ENGLER, Rita C.; MARTINS, Suzana B.; NUNES, Viviane G. A. **Design para a sustentabilidade**: dimensão ambiental. Curitiba: Insight, 2018.

SAMPIERI, Roberto H.; COLLADO, Carlos F.; LUCIO, María del P. B. **Metodologia de pesquisa**. 5. ed. Porto Alegre: Penso, 2013.

SANTOS, Aguinaldo dos. **Seleção do Método de Pesquisa**: Guia para pós-graduandos em design e áreas afins. Curitiba: Insight, 2018. 228 p.

TUKKER, Arnold. Eight types of product-service system: eight ways to sustainability? Expiences from Suspronet. **Business Strategy and the Environment**. v.13, p. 246–260, 2004.

VEZZOLI, Carlo; KOHTALA, Cindy; SRINIVASA, Amrit; DIEHL, J.C; FUSAKUL, Sompit Moi; XIN, Liu; SATEESH, Deepta; SANTOS, Aguinaldo dos; CHAVES, Liliane Iten; CASTILLO, Leonardo A. G.; GÓMEZ, Carla. R. P.; NUNES, Viviane G. A.; LEPRE, Priscilla R.; ENGLER, Rita C.; MARTINS, Suzana B.

**Sistema Produto + Serviço Sustentável**: fundamentos. Curitiba: Insight, 2018. 196 p.

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# PRODUCTION OF SURGICAL BIOMODELS TO SUPPORT SURGERY BY 3D PRINTING: A SOCIAL AND ECONOMIC EVALUATION FROM THE DESIGN FOR SUSTAINABILITY PERSPECTIVE

## *PRODUÇÃO DE BIOMODELOS CIRÚRGICOS DE APOIO À CIRURGIA POR IMPRESSÃO 3D: UMA AVALIAÇÃO SOCIAL E ECONÔMICA NA PERSPECTIVA DO DESIGN PARA A SUSTENTABILIDADE*

## *IMPRESIÓN 3D PARA LA PRODUCCIÓN DE BIOMODELOS DE SOPORTE QUIRÚRGICO: UNA EVALUACIÓN SOCIAL Y ECONÓMICA DESDE LA PERSPECTIVA DEL DISEÑO PARA LA SOSTENIBILIDAD*

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**ABSTRACT**

This article presents, describes, and evaluates, from the perspective of Design for Sustainability (DfS), the social, economic, and technological aspects of the process of developing and manufacturing anatomical biomodels to support surgery using 3D printing in a Brazilian public hospital. This process had an interdisciplinary character, involving professionals of Design, Odontology, and Physiotherapy. The assessment was carried out using DfS (Design for Sustainability) social and environmental heuristics (guidelines), and enabled the identification of relevant aspects, as well as opportunities for improvement in processes. Among the results, the importance of having a specific space dedicated to digital manufacturing in public hospitals stands out, which speeds up the development of biomodels, as well as the quantity, diversity, and quality of 3D printing equipment, which allows the exploration of multiple possibilities for processes and materials, speeding up innovation in the hospital environment.

**KEYWORDS**

Public health; surgery; biomodels; 3D printing; product design.

***RESUMO***

*Este artigo apresenta, descreve e avalia, sob a perspectiva do Design para Sustentabilidade (DfS), os aspectos sociais, econômicos e tecnológicos do processo de desenvolvimento e fabricação de biomodelos anatômicos para apoio a cirurgias com uso de impressão 3D em um hospital público brasileiro. Esse processo teve caráter interdisciplinar, envolvendo profissionais de Design, Odontologia e Fisioterapia. A avaliação foi realizada por meio de heurísticas socioambientais (diretrizes) DfS (Design for Sustainability) e possibilitou a identificação de aspectos relevantes, bem como*

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*oportunidades de melhoria nos processos. Entre os resultados, destaca-se a importância de se ter um espaço específico dedicado à fabricação digital em hospitais públicos, o que agiliza o desenvolvimento de biomodelos, bem como a quantidade, diversidade e qualidade dos equipamentos de impressão 3D, que permitem a exploração de múltiplas possibilidades de processos e materiais, acelerando a inovação no ambiente hospitalar.*

### *PALAVRAS-CHAVE*
*Saúde pública; cirurgia; biomodelos; impressão 3D; design de produto.*

### *RESUMEN*
*Este artículo presenta, describe y evalúa, desde la perspectiva del Diseño para la Sostenibilidad (DfS), los aspectos sociales, económicos y tecnológicos del proceso de desarrollo y fabricación de biomodelos anatómicos para soporte de cirugías mediante impresión 3D en un hospital público brasileño. Este proceso tuvo un carácter interdisciplinario, involucrando a profesionales del Diseño, Odontología y Fisioterapia. La evaluación se realizó mediante heurísticas socioambientales (directrices) DfS (Diseño para la Sostenibilidad) y permitió identificar aspectos relevantes, así como oportunidades de mejora en los procesos. Entre los resultados destaca la importancia de contar con un espacio específico dedicado a la fabricación digital en los hospitales públicos, lo que agiliza el desarrollo de biomodelos, así como la cantidad, diversidad y calidad de los equipos de impresión 3D, que permiten explorar múltiples procesos y posibilidades materiales, acelerando la innovación en el entorno hospitalario.*

### *PALABRAS CLAVE*
*Salud pública; cirugía; biomodelos; Impresión 3d; diseño de producto.*

## 1. INTRODUCTION

The inclusion of new technologies in the health sector represents an important strategy in the search for improvements in health care, and this requires innovative proposals and ideas in development and processes, in addition to the design of products to increase the quality of health care practices. in Brazil (Oliveira and Rodas, 2017; Fabris, Vicentin, Sampaio, 2023). In healthcare, the use of three-dimensional technologies, also known as additive manufacturing (AM) or rapid prototyping (PR), has enabled the expansion of innovative techniques involving customization and personalization of medical products and equipment. (Matozinhos, 2017). AM, as it presents a wide field of applicability, has stood out as a promising method for prototypes and final parts (Paiva; Nogueira, 2021). The search for alternatives for health treatments has led to AM applications being incorporated into a variety of medical techniques and procedures, contributing significantly to several areas, such as oral and maxillofacial surgery, dentistry, neurosurgery, orthopedic surgery, among others (Dod; Jibhakate; Walke, 2023).

Of particular note in this study is oral and maxillofacial surgery, which has excelled with the emergence of these new technologies, which enable better diagnosis and surgical planning for craniofacial disorders. Examples include orthognathic surgery, maxillofacial reconstructions, and temporomandibular prostheses, which, through three-dimensional virtual planning, allow customizing prostheses, surgical guides, fixation plates, among others (Lima, et. al, 2023). Conventional surgical planning, although effective, requires an arduous method of manual tracing and plaster casts, in addition to a significant amount of time in its preparation and encompasses several steps that can accentuate flaws and cause inaccuracies in the outcome of surgical treatment (Resnick; Inverso; Wrzosek, 2016).

Unlike conventional surgical planning, the combination of clinical and virtual planning allows for more predictable, personalised, and precise treatment (Lima, et al, 2023). Whether with the manufacture of surgical templates (most common medical applications of 3D printing in routine practice), or in the reconstruction of bone defects, replacement of the temporomandibular joint and more recently the 3D printing of implantable biomaterials using the patient's own image data, either by computed tomography or magnetic resonance imaging (Dod; Jibhakate; Walke, 2023).

Currently, AM allows the creation of biomodels obtained from human anatomy, through the association of imaging systems with computing systems (CAD – CAM). 3D biomodels are produced from patient images acquired by resonance or computed tomography and can be manufactured in nylon using SLS 3D printing technology. The creation of biomodels or anatomical models of RP has played a very important role in Oral and Maxillofacial Surgery and Traumatology, as it allows better surgical planning in all its stages, facilitates visualization of the extent of the injury and the use of materials in the model (Sapphire , 2010), reducing the time of the surgical procedure and consequently the period of anesthesia, as well as the risk of infection, better aesthetic and functional results due to the possibility of measurement and prior conformation of the materials, contributing to the reduction of the total cost of the treatment (Peckitt , 1999; Mazzonetto et al, 2002; Meurer et al, 2003).

To enable the production of these models in public hospitals, the emergence of digital manufacturing laboratories in these institutions has been essential. These spaces, often called "healthcare fab labs," provide an environment where digital manufacturing technologies such as 3D printing, laser cutting, CNC machining and electronics are applied to the healthcare context. The Digital Manufacturing and Innovation Center (Fab.i HU) at the University Hospital of Londrina (HU UEL) is one of these digital manufacturing laboratories, which had its origins in the COVID-19 pandemic. It is part of the HU UEL structure and was opened in April 2022, with several FDM and LCD printers, 3D scanners and computers with 3D modeling software to develop projects and health products. It is in this space that the solutions presented in this article were developed, having as reference a development process in which Design assumed a fundamental role, and which will also be presented and discussed in this article.



## 2. THEORETICAL FRAMEWORK

- **The importance of Craniomaxillofacial Reconstruction**

Craniomaxillofacial deformities cause significant harm to patients, as they generally cause aesthetic sequelae that hinder social integration, compromise their quality of life and interfere with self-esteem. Furthermore, it causes serious functional sequelae, such as changes in the visual field, breathing, speech, chewing impairment and other mandibular functions (Freitas, 2006). These defects can be congenital or acquired, such as those arising from trauma, infections, bone resorption, resection of facial neoplasms,

among others. In these surgical interventions, the importance of reconstructing the deformity, restoring function and facial harmony stands out, aiming for a satisfactory result (Gouveia, 2009).

Biomodels obtained by 3D printing are physical replicas of anatomical structures and allow three-dimensional visualization of the structures and their changes. They allow the advantage of evaluating the exact extent of the resection, the size and shape of the graft to be used, in addition to allowing pre-operative modelling of the plate, which considerably reduces surgical time (Gouveia, 2009). In this article, three biomodels developed at Fab.i HU will be presented and discussed, as well as an evaluation of these in terms of social and economic aspects, from the perspective of Design for Sustainability.

- **Application of 3D printing in the planning of bucocraniofacial surgeries**

3D printing has revolutionized several sectors of society, from manufacturing to medicine. In the field of healthcare and surgery, this innovative technology is playing a crucial role in enabling the creation of precise anatomical models, personalized medical devices, and even functional human organs. With continued advancements and a growing understanding of its applications, 3D printing is shaping the future of healthcare in unprecedented ways.

One of the most promising aspects of 3D printing in medicine is the ability to produce accurate and detailed anatomical models from medical imaging data such as computed tomography (CT) scans and magnetic resonance imaging (MRI) scans. The images obtained from CT scans and MRIs are stored in a format called DICOM (Digital Imaging and Communication in Medicine), containing information about bone structure and tissues, allowing digital analysis and separation of the desired structures, with which it is possible to create a piece three-e-dimensional model that can be used to reproduce, via 3D printing, a model that provides surgeons with a tangible physical representation of the patient and the target area of surgery (Jacobo et al, 2023).

This allows healthcare professionals to study the patient's anatomy in greater detail, plan specific surgical approaches and rehearse complex procedures before the actual operation (Matozinhos et al, 2017). Additionally, these models can be used to educate patients and their families about planned procedures, increasing understanding and acceptance of medical and dental interventions. 3D printing can also be used to simulate complex surgeries, helping surgeons develop their skills and perfect techniques before entering the operating room.

In the biomodelling of anatomical parts, 3D printing has proven to be a useful tool, whether in surgical planning, in the manufacture of personalized prostheses and in the execution of surgery, resulting in better functional and aesthetic results, as well as a reduction in risks and costs (Gouveia, 2009). Surgical methods became safer and more reliable as advances in radiology, such as computed tomography and clinical analysis methods were introduced into practice (Gouveia, 2009).

Currently, most biomodels reproduce the patient's own bone structures and are constructed from computed tomography (CT). These help the surgical team to understand the shape, relative location, orientation, and size of the anatomical structure in question (Gouveia, 2009). In some cases, biomodels are cut, sanded, and reconstructed before surgery, sometimes being sterilized, and taken to the operating room to assist on site as a visualization tool for surgical intervention (Petzold, 1999; Gouveia, 2009).

- **3D printing applied to healthcare and surgery: types of systems**

3D printing systems known as FDM (Fused Deposition Modelling) and LCD (Liquid Crystal Display) are two popular and affordable 3D printing technologies that can be used to produce these models, each with its own characteristics and applications.

Fused Deposition Modelling, or FDM, is a 3D printing process that involves depositing molten thermoplastic material, layer by layer, to build a three-dimensional object. The material is fed through a heated nozzle and deposited onto a build platform, rapidly solidifying upon deposition (Kumar and Pumera, 2021). This process uses thermoplastic materials, such as PLA (polylactic acid), ABS (acrylonitrile-butadiene-styrene) and PETG (Polyethylene Terephthalate Glycol), and its main advantage is that it is an accessible and suitable technology for reproducing bone models, allowing printing in large formats. Each material has distinct characteristics and must be chosen according to the needs of the model to be prototyped.

Liquid Crystal Display (LCD) technology is a 3D printing method that uses a photosensitive liquid resin. A thin layer of resin is exposed to ultraviolet light through a liquid crystal screen, which acts like a mask, solidifying the exposed areas (Kumar and Pumera, 2021). This process is repeated layer by layer until the object is completely formed. This technology achieves greater levels of detail and

precision, but more affordable equipment has printing areas small, which makes the production of bone models difficult. However, this problem has recently started to be overcome with the arrival on the market of equipment with a larger printing volume, and at a very affordable cost.

Despite advances in recent years, 3D printing in healthcare and surgery also faces significant challenges. The safety, regulation and validation of 3D printed devices are areas that require continuous research and development, in addition to lacking explicit regulation. In short, 3D printing is playing a transformative role in healthcare and surgery, revolutionizing the way healthcare professionals approach diagnosis and treatment. With the ability to create precise anatomical models, this technology is opening doors to a future where healthcare is more effective, personalized, and accessible. Although challenges remain, the potential positive impact of 3D printing on medicine is undeniable.

- **Digital manufacturing labs in hospitals: The Fab.i HU**

Fab.i HU is a laboratory linked to the research project No. 12565/2020 and was institutionalized by HU UEL in April 2021. HU UEL is a Supplementary Body of the State University of Londrina (UEL), being recognized by the Ministry of Education and Ministry of Health, under the terms of Interministerial Ordinance MEC/MS No. 1,213 of 05/30/2014, as well as Health License (verification code No. 8264312). HU UEL is the second largest public hospital in Paraná, being considered a strategic and traditional reference centre in medium and high complexity, 100% SUS (Unified Health System). It is worth mentioning that HU UEL was one of the references and support in the Covid_19 epidemic in the State of Paraná.

Since its institutionalization, Fab.i HU has already developed several solutions for the areas of Paediatrics, Pulmonology, Burn Treatment Centre (CTQ), Dentistry/ Oral and Maxillofacial Surgery, and is now seeking to expand its reach to other areas of health from hospital. Having the laboratory integrated into the hospital structure has several advantages, among which we can highlight:

- Medical customization: allows the creation of personalized medical devices, prosthetics and implants adapted to the specific needs of patients. This can result in more effective treatments and a better quality of life.
- Cost savings: On-site manufacturing of medical devices reduces costs compared to purchasing commercial devices. Additionally, customization can eliminate the need for subsequent adjustments, saving time and resources.
- Rapid prototyping: Rapid prototyping allows healthcare professionals to test ideas and designs before larger-scale production, accelerating medical innovation.
- Reduction in surgery/hospitalization time: with the ability to produce models so that the medical team can practice the surgical procedure or even carry out measurements to produce implants and prostheses, the patient's time in the surgical centre is reduced, generating savings, and promoting shorter anaesthesia time. This means the patient spends less time in the hospital, as it allows for a faster recovery.

In addition to these advantages, the fact that the laboratory is linked to the Hospital allows for multidisciplinary collaboration, generating more efficient and comprehensive solutions, in addition to allowing efficient management of resources, including financing, space and personnel. Compared to traditional fab labs, as they have a specific medical context, at Fab.i HU the R&D team ends up having a deeper understanding of medical needs, allowing the creation of more targeted solutions. Proximity to doctors and patients makes it easier to test and implement innovative devices and solutions. Additionally, the presence of healthcare professionals can guide the design of solutions that meet medical safety and effectiveness standards.

But there are also disadvantages, such as regulatory complexity. Medical devices are subject to strict regulations and healthcare laboratories must ensure compliance with standards and approvals. Furthermore, they end up having limited resources, as they depend on bidding and must follow bureaucratic procedures that often end up making certain applications unfeasible. In summary, digital manufacturing laboratories in hospitals represent an important milestone in the convergence between healthcare and technology. These spaces offer a platform for personalized medical innovation, although they present regulatory and resource challenges. Compared to traditional fab labs, healthcare labs stand out for their medical specialization and clinical integration.

## 3. METHODOLOGY

In addition to a bibliographical review, the method used in this study is the case report of the development of three artifacts (jaw biomodel for orthognathic surgery, skull biomodel for craniomaxillofacial reconstruction surgery, and skull biomodel for bone dysplasia correction surgery), from which a qualitative assessment was carried out based on social and economic heuristics, based on Santos, et al (2019).

## 4. RESULTS

Below are three biomodels that were prototyped by Fab.i HU in response to the request of the hospital's Oral and Maxillofacial surgical team: 1) biomodel to support orthognathic surgery (jaw printed in green PLA); 2) biomodel to support craniomaxillofacial reconstruction surgery (skull printed in crystal liquid resin) and 3) biomodel to support bone dysplasia correction surgery (jaw printed in crystal PETG).

- **Biomodel 1: Orthognathic surgery**

Orthognathic surgery is a procedure used to correct facial asymmetry to correct and reposition the jaw bones, and, consequently, the dental positioning of patients who have different degrees of asymmetry in the region (Modonesi et.al, 2017). In this case, the 3D model of the mandible in stl format was opened in the Rhinoceros 7 software for verification together with a professional from the surgical team, and then imported into the Ultimaker Cura software to generate a gcode file, which was then sent to be printed on an Ender 5 Plus 3D printer, in 1.75mm PLA plastic filament, in green, using a 0.4mm printing nozzle. The printing took approximately 6 hours, and the model proved to be suitable for the intended purpose of surgical planning, allowing it to be machined with micro-grinding equipment (Figures 1a and 1b).

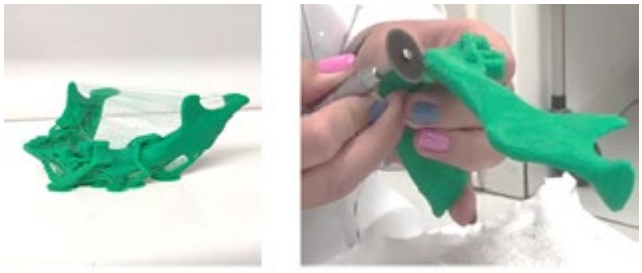


**Figure 1:** Mandible printed in PLA with the impression supports (a) and being machined by a professional from the surgical team in the surgery planning stage (b).
**Source:** prepared by the authors.

- **Biomodel 2: Craniomaxillofacial deformity**

To optimize the results of craniomaxillofacial reconstructions, careful planning is necessary with excellent anamnesis, pre-operative preparation, imaging tests, creation of biomodels, selection of the biomaterial indicated for reconstruction and, above all, choice of the appropriate surgical technique. Depending on the complexity of the cases, a multidisciplinary approach is required. For this application, the 3D model in stl format provided by the surgical team was also reviewed in the Rhinoceros 7 software together with a professional from the surgical team. However, the generation of the print file was done using the Halot Box software, specific to the Halot One printer, as the laboratory team wanted to experiment with the use of resin printing to evaluate the viability of this technology in surgical biomodels. A 3D model of a male skull was printed, which had to be produced in parts due to the small size of the equipment's printing area. After removing the part, the printing supports and washing to remove excess resin, the parts were subsequently joined using resin applied with a brush, followed by curing by ultraviolet rays in equipment suitable for this purpose.

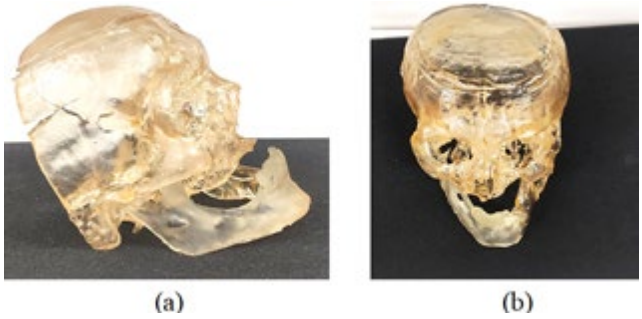


**Figure 2:** Skull printed in resin on an LCD printer, in side (a) and front (b) views.
**Source:** prepared by the authors.

The process proved to be viable, although laborious, as the assembly was done by hand. However, this difficulty

can be overcome with the use of larger volume resin printers, currently available on the market and at a viable cost (around R$5,000). The model presented a high quality of finish (Figures 2a and 2b), but also excessive rigidity for the need for machining by the surgical team. It is worth noting that the laboratory has six Halot One equipment, two of which are intended for printing in rigid resin like the one used in this biomodel, and the others for testing with other types of resin, such as flexible or pigmented).

- **Biomodel 3: Bone dysplasia**

Bone dysplasia is described as a benign disorder of bone development, characterized by the replacement of normal bone by an excessive proliferation of fibrous connective tissue. A piece obtained from the CT image of a patient who had bone dysplasia was manufactured for the surgical procedure of osteoplasty in the maxillary region. As with previous biomodels, this part was printed from a stl file provided by the surgical team, using Rhinoceros 7 software for evaluation and Ultimaker Cura to generate a gcode file for 3D printing.

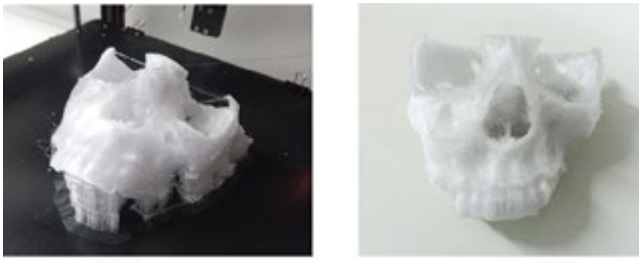


**Figure 3:** Skull printed in PETG, with printing supports (a) and front (b).
**Source:** prepared by the authors.

This piece was printed on an Ender 5 Plus printer but, unlike biomodel 1, 1.75mm PETG filament was used with a 1mm printing nozzle. Therefore, biomodels 1 and 3 were printed on two different FDM printers, which was possible since the laboratory has four pieces of equipment of this type. The objective of using the 1mm nozzle is to reduce printing time on parts that do not require very high precision, as was the case with biomodel 3.

- **Development and manufacturing process**

The creation of the three biomodels followed the same basic work process, but with some specificities for each of the pieces, as follows:

- Receipt of the 3D file of the object to be printed in stl format, delivered by a professional from the surgical team.
- Conference of the 3D model together with the surgical team professional.
- Discussion with the requesting professional about the attributes that the material should fulfil to meet the needs (surface quality, malleability, mechanical resistance, hardness level, ease of cutting, machining and pen markings, absence of post-printing lint), as well as the deadline for delivery of the part.
- Definition of printing material, layer resolution, fill level, use of supports and other printing parameters.
- 3D printing of the biomodel.
- Removal of printing supports, cleaning, curing (resin printing) and finishing.
- Delivery of the biomodel to the surgical team.

Next, the development of these biomodels will be discussed from aspects of social and economic sustainability, from the perspective of Design for Sustainability, and based on the heuristics described by Santos, et al (2019).

## 5. ANALYSIS OF RESULTS

- **Aspects of social sustainability: benefits for the hospital's internal and external public**

The evaluation of the social aspects of the processes described above was carried out considering the following heuristics, as proposed by Santos et al (2019): improve working and employment conditions; favour the inclusion of everyone; improve social cohesion; value local resources and skills; promote education in sustainability, and instrumentalize responsible consumption. Of these, three were considered relevant to this study, and are discussed below.

*Improve working and employment conditions*

In this case, we can see an improvement in working conditions for surgical professionals, who, with the use of biomodels, begin to perform faster, safer, and therefore less tiring and stressful surgeries, with direct impacts on the well-being of patients. surgical patients, who, thanks to the reduction in surgery time, also have their risk level (contamination, complications) and stress reduced. In this aspect, surgical team professionals reported, for example, reductions in surgery time from more than five hours to less than two hours, a significant gain thanks to the use of biomodels for prior surgery planning.

*Encourage the inclusion of everyone*

The use of surgical biomodels and the reduction in surgery time also imply the possibility of performing new surgeries, expanding the reach of the public health service to more patients. Considering that a large part of the public that seeks care at HU UEL is low-income, there is an obvious social benefit in favouring the inclusion of these people in care, which is provided entirely via SUS. The incorporation of 3D printing in this case presents benefits that can be concretely perceived by the population.

*Valuing local resources and skills*

The digital manufacturing of biomodels located within the hospital can be considered an example of distributed production, in which the production and distribution of goods is carried out locally and decentralized, without direct dependence on a few producers who are far from consumers. Although the equipment and inputs originate from suppliers far from the hospital, once the 3D printing infrastructure is installed, the hospital gains greater autonomy in the development, production, testing and delivery of solutions. Therefore, we start using a local resource (in this case the 3D printing laboratory) and local skills (in this case the laboratory team, made up of researchers, professors, and students from the university to which the hospital belongs).



- **Aspects of economic sustainability: benefits for the hospital and the SUS**

The economic heuristics proposed by Santos, et al (2019) refer to: strengthening and valuing local resources; respect and value local culture; promote and local economy; promote network organizations; value the reintegration of waste and promote education for a sustainable economy. Of these, those that we consider most significant in the process of producing surgical biomodels are discussed below.

*Strengthening and valuing local resources*

In addition to the social implications, prioritizing the choice of local resources (material, technical, financial, human) over those of external origin is also an economic heuristic, as it can lead to a gain in competitive advantage. In the case of a public hospital, the main advantage of having the 3D printing laboratory as a local resource is the reduction in costs resulting from the reduction in surgery time, with savings in both team working hours and costs resulting from the reduction of risks, already mentioned previously.

*Promotion of the local economy*

Once installed, to produce biomodels, the laboratory starts to consume different types of inputs (filaments, glues, spare parts), as well as maintenance and repair services that can be purchased from local companies, which helps to strengthen chains of value in the city itself, generating work and local income. Furthermore, the technical-scientific knowledge generated in the laboratory and disseminated through articles, reports, lectures, courses, and other forms of dissemination enables other actors external to the hospital to also create new business models, thus encouraging locally based entrepreneurship, which is also favoured by the existence of an innovation agency at the university to which the hospital is linked.

*Promotion of networked organizations*

The development of biomodels involves the interaction of professionals from different areas (design, physiotherapy, dentistry, medicine, surgery), in an interdisciplinary way. This interaction can occur both within the hospital and outside it, with professionals from other institutions, both public and private, which enables the exchange of information and knowledge that leads to the creation of a virtuous circle of learning with consequences for the entire health system. In this sense, it is important that the hospital offers a good information technology structure, with a quality intranet and internet and good work equipment. In a broader and more systemic way, the creation and strengthening of these network organizations also allows the health system to increase its resilience to respond with more agility, assertiveness, and efficiency to future critical situations, such as the pandemic that occurred in recent years.

*Technological aspects: challenges and benefits*

The main technological challenges to produce biomodels are also common to other types of artifacts developed by Fab.i HU, the main ones being the following:

- Constant need for technological updating, both in equipment and materials and processes, with a risk of rapid obsolescence in both.
- Infrastructure maintenance, mainly 3D printing equipment.

- Constant need to search for sources of financing, both for the infrastructure and for the maintenance of qualified technical personnel to operate the equipment.
- Growing demand for products and services by the hospital, requiring expansion of the centre's service capacity.
- Dependence on labour provided by the university itself, especially research professors and research fellows with short-term contracts that need to be renewed annually. In the case of new fellows, training is required to enable them to use the laboratory's infrastructure and internal processes.

These challenges point to the need to develop and execute an innovation policy and strategy appropriate for the laboratory, which must necessarily include technological, economic-financial, informational, intellectual, social, and environmental capital dimensions.

*Environmental aspects: a future challenge*

The environmental aspects involved in the production of biomodels for surgical use are one of the topics to be investigated in the future by the team, which should be done considering both the search for greater environmental efficiency (eco-efficiency) in the life cycle of biomodels, and the dematerialization in production and consumption (focusing on the final benefit rather than the product itself). In this sense, some aspects have already been identified by the team, including energy consumption, reduction in material waste and the possibility of reuse and/or recycling, which will be investigated in a future article.

## 6. FINAL CONSIDERATIONS

In this work it was possible to understand the relevance of using 3D printing in the production of biomodels for surgical use, as an important instrument for the prior planning of surgeries, as well as the importance of having a laboratory dedicated to this activity within a public hospital, equipped with quality equipment and in good quantity. The importance of adopting an interdisciplinary process between different areas was also highlighted, including Design, Physiotherapy, Dentistry and Medicine, especially for professionals who work in a surgical environment. The social and economic benefits were evaluated using Design for Sustainability heuristics, which allowed a more specific reading of these, highlighting relevant aspects, as well as opportunities for improving processes. The environmental dimension will be explored by the Fab.i HU research team in future studies.

## REFERENCES

FABRIS LUIZ, S.M; VICENTIN, J.A, SAMPAIO, C.P. **ENSUS 2023 – XI Encontro de Sustentabilidade em Projeto** – UFSC – Florianópolis – 05 a 07 de Junho de 2023.

FREITAS, R. Tratado de Cirurgia Bucomaxilofacial. São Paulo, Editora Santos, 2006.

GAURAV, D; JIBHAKATE, R; PRAMOD WALKE, A. Review on 3D printing maxillofacial surgery: Present work and future prospects, **Materials Today: Proceedings**, 2023.

GOUVEIA, M.F. Aplicação da prototipagem rápida no planejamento de cirurgias craniofaciais. **Tese de doutorado apresentada à comissão de Pós-graduação da Faculdade de Engenharia Mecânica, como requisito para a obtenção do título de Doutor em Engenharia Mecânica**. Campinas, SP, 2009.

JACOBO, O.M., et al. Three-dimensional printing modeling: application in maxillofacial and hand fractures and resident training. **Eur J Plast Surg** 41, 137–146, 2023. Disponível em: https://doi.org/10.1007/s00238-017-1373-0. Acesso em: 30 ago 2023.

KUMAR, K. P. A.; PUMERA, M. 3D-Printing to Mitigate COVID-19 Pandemic. Advanced Functional Materials, v. 31, n. 22, p. 2100450, 2021. Disponível em: https://onlinelibrary.wiley.com/doi/10.1002/adfm.202100450. Acesso em: 30 ago 2023.

LIMA, F.G.G. P., et al. Planejamento Virtual e novas tecnologias em cirurgia buco-maxilo-facial. **Repositório.ufu.br**, 2023.

MATOZINHOS, Isabela Penido et al. Impressão 3D: Inovações no campo da medicina. **Revista Interdisciplinar Ciências Médicas**-mg, Mg, p.143-162, 2017. Disponível em: http://200.169.1.56/ojs/index.php/ricm/article/view/14/11. Acesso em: 30 ago 2023.

MAZZONETTO, R. et al. Uso de biomodelos esteriolitográficos em cirurgia bucomaxilofacial. **R. Assoc. Paul. Cir.**

**Dent**., São Paulo, v.56, n.2, mar./abr. 2002.

MEURER, E. et al. Os biomodelos de prototipagem rápida em cirurgia e traumatologia bucomaxilofacial. **R. Bras. Cir. Periodontia**, Curitiba, v.1, n.3, p.172-180, 2003.

MODONESI, et. Al. Cirurgia Ortognática: Assimetria Facial e a Limitação do Planejamento Manual: Correção com Planejamento Virtual (3D): Relato de caso. **FOL** - Faculdade de Odontologia de Lins/Unimep, 27(2) 63-73, jul.-dez. 2017.

PAIVA, T. N.; NOGUEIRA, C. C. Estudo comparativo das principais tecnologias de impressão 3D no Brasil. **Jnt-Facit Business and Technology Journal**, v. 1, p. 179–190, 2021.

PECKITT, N. S. et al., The cost of treatment. Disponível em: http://www.maxfac.com/cost1.htm. Acesso em: 29 ago. 2023.

PETZOLD, R.; Zeilhofer, H. F.; Kalender, W. A. "Rapid prototyping in medicine – basics and applications. Computerized Medical Imaging and Graphics", Tarrytown, NY., v. 23, n.5, p.277-284, Sep./Oct. 1999.

RESNICK, C. M.; INVERSO, G.; WRZOSEK, M. Is There a Difference in Cost Between Standard and Virtual Surgical Planning for Orthognathic Surgery? **Journal of Oral and Maxillofacial Surgery**, v. 74, n. 9, p. 1827–1833, 2016. Disponível em: http://dx.doi.org/10.1016/j.joms.2016.03.035. Acesso em: 29 ago 2023.

SAFIRA, L.C; MACIEL, A.S; SOUTO-MAIOR,J.C.C; AZEVEDO,R.A; CAVALCANTE,W.C; FRANCISCHONE,C.E; SARMENTO, V. A. Aplicação dos biomodelos de prototipagem rápida na Odontologia, confeccionados pela técnica da impressão tridimensional. **R. Ci. méd. biol**. 2010; 9(3):240-246.

SANTOS, A. et al. Design para sustentabilidade: dimensão econômica / Organizado por Aguinaldo dos Santos - Curitiba, PR: Insight, 2019.

SANTOS, A. et al. Design para a sustentabilidade: dimensão social / Aguinaldo dos Santos...[et al.] - Curitiba, PR : Insight, 2019.



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GAVS: Investigation, methodology, supervision, validation, visualization, writing – original draft and writing – review & editing.

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# ALTERNATIVE PERSPECTIVES WITH SOCIO-ENVIRONMENTAL EMPHASIS FOR THE FUTURE OF DESIGN

## *PERSPECTIVAS ALTERNATIVAS PARA O FUTURO DO DESIGN COM ÊNFASE SOCIOAMBIENTAL*

## *PERSPECTIVAS ALTERNATIVAS PARA EL FUTURO DEL DISEÑO CON ÉNFASIS SOCIOAMBIENTAL*

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**ABSTRACT**
This article presents the origins and transformations of modern design, which emerged in Europe and was initially associated with the industrialization process. We also present the critique of visionary thinkers such as Morris, Papanek, Manzini, Regenesis Group and Escobar, who suggest a reflection towards socio-environmental issues. Through an articulation among contemporary proposals, the aim is to encourage the reinvention of design methods, guided by an organic, ecological and a process-based worldview, in which the designer can transcend his/her role as a mere executor of capitalist rationale, to become a fundamental agent in the social transition towards regeneration and ecosystem health.

**KEYWORDS**
Design evolution; Design for Sustainability; Regeneration.

***RESUMO***
*Neste artigo são apresentadas as origens e transformações do design moderno, que tem seu surgimento na Europa e foi inicialmente vinculado ao processo de industrialização. Apresentamos também a crítica de visionários como Morris, Papanek, Manzini, Grupo Regenesis e Escobar, que propõem uma reflexão em direção às questões socioambientais. Através de uma articulação entre propostas contemporâneas pretende-se fomentar a reinvenção dos métodos projetuais do design, guiados por uma visão de mundo orgânica, ecológica e processual, em que o designer possa transcender a sua função como mero executor de lógicas capitalistas, para tornar-se um agente fundamental na transição social rumo à regeneração e saúde ecossistêmica.*

***PALAVRAS-CHAVE***
*Evolução do design; Design para a sustentabilidade; Regeneração.*

***RESUMEN***
*Este artículo presenta los orígenes y transformaciones del diseño moderno, surgido en Europa y vinculado inicialmente al proceso de industrialización. También presentamos las críticas de visionarios como Morris, Papanek, Manzini, Grupo Regenesis y Escobar, quienes proponen una reflexión hacia las cuestiones socioambientales. A través de una articulación entre propuestas contemporáneas, se busca incentivar la reinvención de los métodos de diseño, guiados por*



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*una cosmovisión orgánica, ecológica y procesal, en la que el diseñador pueda trascender su papel de mero ejecutor de las lógicas capitalistas, para convertirse en un agente fundamental. en la transición social hacia la regeneración y la salud de los ecosistemas.*

***PALABRAS CLAVE***
*Evolución del diseño; Diseño para la sostenibilidad; Regeneración.*

## 1. THE EMERGENCE OF MODERN DESIGN IN EUROPE

Forty (2007) criticizes the way in which design historians focus on studying the "characters" of design and do not actually analyze the social and economic context, which, in reality, helps to shape the development of design. Their work is fundamental to understanding the contribution of design in the processes of symbolic production that generate our lifestyle – ways of working, producing and consuming.

The beginning of modern industrial design originated from the need to separate the stages of manufacturing production. According to Forty (2007), entrepreneurs wanted to optimize and increase their production in order to obtain greater profits, and this led to a progressive exploitation of the work of people - who in the past, as artisans, had mastered the entire process of producing products. In this way, and seeking to "make machines out of men" (Forty, 2007, p. 49), entrepreneurs opened up a job position that concentrated on creating and guiding the manufacturing of products, which also began to rely on the help of machines. In other words, modern design arose from industrial capitalism's need to standardize and generate "surplus value".

Cardoso (2000) presents the transformations that occurred throughout the 18th century, caused mainly by organizational changes - in work, production and distribution – rather than, strictly speaking, by technological changes, mechanization. Namely, the increase in the scale of production and size of factories, as well as the serialization of production and the progressive specialization of work. It should be added that such transformations were only possible due to the dismantling of artisan guilds that, in a certain way, protected free artisans (Cardoso, 2000).

> Instead of hiring many skilled artisans, all that was needed was a good designer to generate the project, a good manager to supervise production and a large number of workers with no qualifications at all to carry out the steps, preferably as mere machine operators. The high remuneration of the first two was more than offset by the demeaning salaries paid to the last, with the additional advantage that they could be fired without risk in times of low demand. Thus, serial production based on a project saved the manufacturer not only time but also money. (Cardoso, 2000, p. 28).

No matter how good the designer is, however, he/she is not autonomous and his/her decision-making power is limited. Their productions are ultimately carried forward, produced, only by the entrepreneur's choice. For a long time, the discussion about design was based on technical and artistic issues, linked to a supposed "good shaping" of products, which hinders the awareness and the discussion of the socioeconomic systems that lead, firstly, to the adoption of certain work relationships, and also values and "myths", which products seek to embody and thus become more attractive and saleable (Forty, 2007). Talking about modern design is to talk about an activity that has always been at the service of the capitalist productive modes.

There were designers who fought for an altruistic objective, that of, through design and mechanization, enabling access to quality products for the general population. However, such attempts were often frustrated, as access to these products was limited to an intellectual and economic elite (Pevsner, 2002).

In this sense, we have a clear picture of how the economy was progressively developing and determining the way we interact and live. We have, at the same time, an economy that determines how society should behave and live, and also extracts "value" from nature, from environmental resources. Within this logic, modern design emerges and is developed, seeking better results for organizations - generally regardless of the socio-environmental impacts caused.

It is important to understand that, until the 16th century, economic phenomena were not isolated from the rest of reality, "from the fabric of life" (Capra; Luisi, 2014, p. 74). The rise of capitalism was the consequence of an enormous transformation of values, which began at the end of the Middle Ages and at the beginning of the Renaissance, and which was completed in the process of industrialization. Between 1500 and 1700 the entire worldview and value system in Europe underwent a major transformation, and such perspective and values contributed to the foundations of the modern industrial era (Capra; Luisi, 2014). What we know as the Scientific Revolution was also responsible for establishing a new world perspective that replaced the organic and integrated perspective with the machine metaphor. In this context, administrative methods for organizations also became mechanistic. In other words, well before the mechanization of organizations, they were already adopting Cartesian and mechanistic methods, whose objective was to increase productive efficiency.

## 2. CRITICS OF MODERN DESIGN

There were opponents to this model, such as William Morris, a socialist, who was a fierce critic of this performance of design at the service of capitalism in the context of mechanization. "It is not this or that tangible machine of steel and metal that we want to get rid of, but the great intangible machine of commercial tyranny, which oppresses the lives of all of us" (Forty, 2007, p. 85). William Morris, in addition to being a designer, was a painter, writer, poet, social reformer and protagonist of the Arts and Crafts movement. He sympathized with the mass of workers exploited by the capital and believed that "as long as work was a commodity used for the profit provided to non-workers, human beings in general would not be able to live in effectively human conditions" (Araújo, 2014, p. 26).

Morris wrote a novel called "News from Nowhere" in 1891, where he presented a utopia that was also a precursor to ecological utopia. In this novel he envisioned a future (in the year 2102) where people lived in a reality other than that of capitalism. In this scenario, people understand work as art, and art as life. There is also no difference between countryside and city, people live in a healthy, clean natural environment, there is no private property, not even commerce. People produce what they need in workshops, and they do it with great quality and only to the extent of their needs. There is no distinction in value between intellectual work and manual work. In other words, Morris imagines an egalitarian and free society, where people enjoy working, because this work is creative, at the service of the community, and the worker also has the freedom to choose their own path (Araújo, 2014). We can say that Morris was a precursor, within the field of design, of a type of work and aesthetic proposition, which have been emerging over the last few decades.

Without going that far, there were other designers who questioned the current way of designers' work and capitalist production itself, for example, Victor Papanek. Papanek was a precursor of the Design for Sustainability, in which he realized the importance of considering the environmental impacts of design. Papanek (1990) states that there are few professions as dangerous as industrial designing. Because in this era of mass production, design shapes tools, the environment and, consequently, man himself.

It is clear that this is not due to just individual brilliance. Between the 1960s and 1980s, sensitivity towards the environment gained relevance, especially after the publication of the book "Silent Spring" by Rachel Carson (1962). Important reports were published about the limits of growth and problems inherent to the current economic development models. In 1973, for example, Maurice Strong used the concept of eco-development as an alternative development policy for the first time.

> It basically integrated six aspects, which should guide the paths of development: a) the satisfaction of basic needs; b) solidarity with future generations; c) the participation of the population involved; d) the preservation of natural resources and the environment in general; e) the development of a social system guaranteeing employment, social security and respect for other cultures, and f) education programs. (Bruseke, 1994, p. 15).

This criticism towards industrial society and industrial modernization as a development policy for peripheral regions was transformed over the following decades, adapting, in a certain way, to the current policy. The 1987 Brundtland Report is the result of the work of the United Nations Conference on Environment and Development (UNCED) (Bruseke, 1994, p. 16) and it was decisive for the notion of Sustainable Development: "development that meets the needs of the present without compromising the ability of future generations to satisfy their own needs" (Cavalcanti, 1994, p. 92).

As we, while society, question the impact of the thought of progress and development, we envision other means to reach a more balanced and beneficial configuration of society (and modes of production) for the whole. In other words, within a capitalist notion but without, however, the intention of revolutionizing this socioeconomic reality, many other designers proposed adaptations in their design approaches to deal with the systemic problems caused by industrial production. Whether this is actually possible, it is another question to be addressed.

Manzini, in 1990, defends an ecological attitude among designers, which should guide design and production processes. In other words, he defends respect for nature, in which a value is assumed that goes beyond the posture of domination and control of nature so highlighted by modern thought, without falling into submission to an idealized nature at all. Manzini (1990) proposes that designers think systematically, during the design process, at hierarchical levels, such as the planet, the region, physical and cultural places, the external and internal microenvironments, which constitute the immediate environment,

and of course, the objects - of low environmental impact. In the face of the growing world population, the author does not believe that there is any other solution other than a consistent technical-scientific support, an adequate production, and an eco-technological balance (Manzini, 1990).

Manzini says that sustainability requires a systemic discontinuity, that is, we should move from a society with increasing levels of production and consumption to a society that decreases such levels, simultaneously increasing the quality of the entire social and physical environment (Manzini, 2008, p 19). To this end, the author argues, we will have a transition based on large-scale social learning, where a major change in values and the very notion of well-being is at stake. In this scenario, collaborative organizations and participatory work are important, involving not only designers and manufacturers, but all consumers and beneficiary citizens.

## 3. A NEW GENERATION OF DESIGNERS

In the same decade of 1990, the Regenesis group, formed by authors such as Bill Reed, Pamela Mang, Ben Haggard, among others, proposed the regenerative design. Given the scarcity of results from a community committed to sustainability, Mang and Reed (2012) observe the insufficiency of their methods, agendas and strategies. Those strategies are committed to reducing or eliminating the negative impacts of human action on the environment, that is, they are still far from a model that must be based on a distinct worldview. Proponents of regenerative design base their elaborations on ecology and systemic thinking about life. As proposed by Capra, they understand that Nature should not be reduced to a machine, which human beings can operate and explore, following anthropic and non-ecological logics. In this way, they intend, not only to mitigate the damage created by human beings, but to seek an adequate co-evolution of human systems with their socio-ecological ecosystems. This proposal is in line with a movement in the field of design for sustainability in which approaches move from technological and product areas to socio-technical areas (Ceschin; Gaziulusoy, 2016). Regenerative design then emphasizes the search for the necessary transformation in models of thought and design practices, which involves adopting different paradigms, anchored in an ecological worldview.

These understandings are supported by a deep, procedural, complex and respectful ecological perspective of the various ecosystem relationships (between human, non-human, living or non-living actors). Therefore, they escape the modern attempt to bifurcate the world into two different domains: that of Nature (Non-Humans) and that of Culture (Humans) (Latour, 1994). Such separation does not occur in reality, but the natural sciences and the human and political sciences have tried to "purify", isolate and increasingly unfold such domains (Harman, 2009).

In recent decades, we have seen a major transformation in the field of design, and in the very understanding of what design can do. We are even able to arbitrate the birth of this professional field at the time of the industrial revolution, but, as Papanek said, "Design is the conscious and intuitive effort to impose meaningful order" (Papanek, 1990, p. 4), that is, design is an activity common to humans, "the design process constitutes the planning and understanding of patterns of any action to achieve a desirable and prospective end" (Papanek, 1990, p. 322). Manzini also defines "diffuse designers" as people who, through their critical sense, creativity and practical drive, adopt a design approach (Manzini, 2017). In other words, in a contemporary understanding of design there is also a search to subvert it towards more ethical demands, committed to life and planetary health. Not strictly related to making production processes more efficient, products more saleable and richer entrepreneurs, despite the multiple socio-environmental crises. What is more, it is about trying to find radically new ways of designing, which can contribute to fairer, healthier and more prosperous realities for the entire Earth's ecosystem.

However, as already stated, the designer is not an autonomous and almighty being, his/her impact is directly related to the organizations for which he or she designs. In this sense, we understand that effective changes in design methods require another socioeconomic configuration, and for this, there are already some proposals.

## 4. CONTEMPORARY PROPOSALS

Based on contributions from the field of design and regenerative thinking, Fullerton (2015) proposes a Regenerative Economy, or even Regenerative Capitalism. The author starts from the idea that "the universal patterns and principles that the cosmos uses to build stable, healthy and sustainable systems, can and should be used in the real world as a reference model for the design of economic systems", and then outlines eight key principles that underpin systemic health (Table 1).

| | |
|---|---|
| In Right Relationship | Humanity is an integral part of an interconnected web of life in which there is no real separation between "us" and "it." The scale of the human economy matters in relation to the biosphere in which it is embedded. We are all connected; damage to any part of that web ripples back to harm every other part as well. Much work to do here in disconnected, atomized finance, but also, of course, it speaks to the scale of the material throughput of the economic system as a whole. |
| Views Wealth Holistically | True wealth is not merely money in the bank. It must be defined and managed in terms of the well-being of the whole, achieved through the harmonization of multiple kinds of wealth or capital, including social, cultural, living, and experiential. It must also be defined by a broadly shared prosperity across all of these varied forms of capital. The whole is only as strong as the weakest link. Again, finance is ground zero. |
| Innovative, Adaptive, Responsive | In a world in which change is both ever-present and accelerating, continuous learning and the qualities of innovation and adaptability are critical to health. It is this idea that Charles Darwin intended to convey in this often-misconstrued statement attributed to him: "In the struggle for survival, the fittest win out at the expe - se of their rivals."<br>What Darwin actually meant is that: the most "fit" is the one that fits best i.e., the one that is most adaptable to a changing environment. Of all the principles, this one is best understood and accepted in our contemporary paradigm.<br>One out of eight ain't so bad! |
| Empowered Participation | In an interdependent system, fitness comes from contributing in some way to the health of the whole. The quality of empowered participation means that all parts must be "in relationship" with the larger whole in ways that not only empower them to negotiate for their own needs, but also enable them to add their unique contribution towards the health and well-being of the larger wholes in which they are embedded. In other words, beyond whatever moral belief one has, there is a scientifically grounded systemic requirement to address inequality, racism, prejudice and injustice for the health of the whole. |
| Honors Community and Place | Each human community consists of a mosaic of peoples, traditions, beliefs, and institutions uniquely shaped by long-term pressures of geography, human history, culture, local environment, and changing human needs. Honoring this fact, a Regenerative Economy nurtures healthy and resilient communities and regions, each one uniquely informed by the essence of its individual history and place. This principle poses a profound challenge to the modern global corporation, but forward-thinking leaders are already moving toward a more distributed management structure connected to place. |
| Edge Effect Abundance | Creativity and abundance flourish synergistically at the "edges" of systems, where the bonds holding the dominant pattern in place are weakest. For example, there is an abundance of interdependent life in salt marshes where a river meets the ocean. Edges are also where risk lies. At those edges the opportunities for innovation and cross-fertilization are the greatest. Working collaboratively across edges – with ongoing learning and development sourced from the diversity that exists there – is transformative for both the communities where the exchanges are happening, and for the individuals involved. Business leaders understand that the boundary of the firm is no longer the relevant "whole" under management, and partnerships across the public and non-profit sectors are becoming more common. If only Wall Street analysts understood too. |
| Edge Effect Abundance | Just as human health depends on the robust circulation of oxygen, nutrients, etc., so too does economic health depend on robust circulatory flows of money, inform - tion, resources (circular economy), and goods and services to support exchange, flush toxins, and nourish every cell at every level of our human networks. The circul - tion of money and information and the efficient use and reuse of materials are part - cularly critical to individuals, businesses, and economies reaching their regenerative potential. This principle holds the promise of a whole new set of metrics to monitor (alternatives to GDP), and with them, supportive public policy options. |
| Seeks Balance | Being in balance is essential to systemic health. Like a unicycle rider, regenerative systems are always engaged in this delicate dance in search of balance. Achieving it requires that they harmonize multiple variables instead of optimizing single ones. A Regenerative Economy seeks to balance: efficiency and resilience; collaboration and competition; diversity and coherence; and small, medium, and large organizations and needs. It runs directly against the (short term) "optimize" ideology that is at the root of modern financial logic. |

**Table 1** - Eight key, interconnected principles that underlie systemic health.

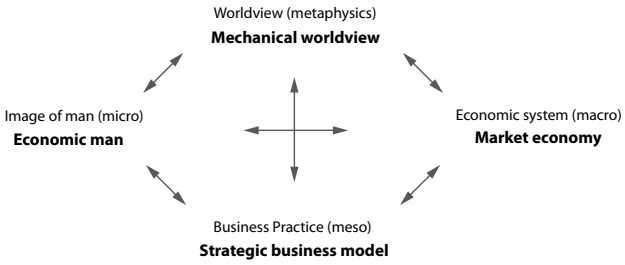
**Fonte:** FULLERTON, 2015.

As far as the author is concerned, it is not a question of choosing between capitalism and socialism, but operating a social and economic transition so that the current system works for people and the planet. The principles outlined above state all sensitivity and coherence regarding the interdependence of systems, as well as a more empowered performance of people and local communities in a vision that expands the concept of wealth beyond the monetary, also encompassing socio-cultural well--being and health of physical ecosystems. However, why the author maintains the term Capitalism in his proposal seems questionable, and it could be a source of investigation for new research.

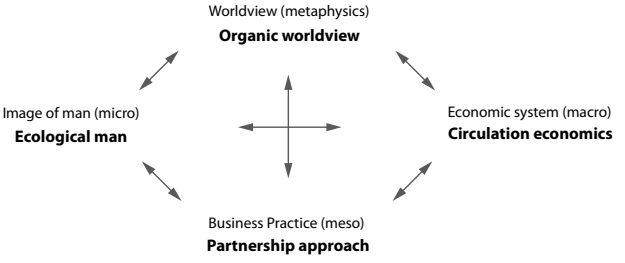
What can be considered more interesting is the utopian narrative of an alternative economic system created by a Norwegian professor of Ecological Economics for more than 20 years, Ove Jakobsen (2017). Jakobsen creates a vision where the economy is nested within and at the service of social and natural ecosystems. In other words, it ceases to be a self-sufficient and dominant system and operates from an ecological perspective. For the author, the implementation of profound transformations depends on our ability to create a new history that, although utopian, is based on the reality in which we live, that is, so that we can criticize and distance ourselves from ideologies that prevent us from achieving harmony between nature and society.

In his book, Jakobsen (2017) presents several theories (among them Whitehead's process philosophy (Jakobsen, 2017, p.10), which also inspired Latour) and introduces a relevant demarcation between what he labels "green economics" and "ecological economics". For the author, "green economics" is part of the current paradigm or ideology, and addresses the symptoms of crises that are rooted in the inadequate way we see and operate in the real world. "Ecological economics" represents an alternative paradigm, or a utopia, which denounces the mechanistic worldview itself as the primary problem that leads us to the current and deficient neoclassical economic paradigm.

In his proposal for "Utopia VSO" (viable organic society), the author details (Pictures 1 and 2) how the ecological economy would work in a future society, in which four interconnected and interdependent dimensions are modified:




**Picture 1 -** Dominant ideology.
**Source:** prepared by the authors based on JAKOBSEN, 2017, p. 214.




**Picture 2 -** Utopia VOS.
**Source:** prepared by the authors based on JAKOBSEN, 2017, p. 214.

Worldview (metaphysics) - from Mechanistic to Organic; Economic system (macro) - from Market Economy to Circulation Economics (circularity); Business Practice (meso) - from Strategic Business Model to Partnership Approach; and the Image of man (micro) - from economic man to ecological man (Pictures 1 and 2). In this future utopian economy, networks, local self-sufficiency, partnerships, distribution/decentralization are valued, in short, a nested economy that favors networks of circular values, where there is a mutual dependence that favors ecosystem health and summons ecocentrism.

In these scenarios imagined by Fullerton and Jakobsen, we find a great opportunity for the development of design, not only in the search for the eco-technological balance advocated by Manzini, which could assist in a positive transition of production models, but also for the critique of current models and the creation of alternative narratives and aesthetics that are in line with a different worldview. How many practices could be deepened and reinvented in the light of new paradigms! The designer could also be a promoter of planetary health and harmonious coexistence of human beings with other natural manifestations. We understand that research into theories that support such a worldview is very fruitful, so that it can inspire design ways that today may seem utopian.

Still in the context of regenerative thinking for the reinvention of design, we have some authors who are references, such as Colombian Arturo Escobar. Similarly,

to Latour, Escobar (2016) addresses the ontological differences in the worldview of the modern West and other cultures, such as ancestral cultures. According to what it presents, the modern West is mainly guided by rationalism, where there is a dual vision, with a clear separation between nature and human beings. According to this modern vision, we create ways of understanding and being in the world that are even "defuturing", according to Tony Fry's proposal (2015). "Defuturing" in the sense that they steal the future conditions for us to live as a society in a healthy way in the world.

However, there are other territorialities (Escobar, 2016, p. 22), which are experienced and constructed from another ontology, a relational ontology, which contrasts with the ontology of modern Western separation and duality. In this other understanding and agency in the world, Colombian indigenous peoples (Kogui, Arhuaco, Wiwa and Kankuamo from the Sierra Nevada de Santa Marta) consider themselves "big brothers" of all humanity, responsible for maintaining universal balance. This balance begins with their territory, which is seen in an integral way where the physical and the spiritual are articulated and where all actors (human and non-human) have a relationship and a place (Escobar, 2016, p. 91-92).



Escobar (2016) also explores design for sustainability, and explains how the framework of 'ontological design' operates a transformation in the way we perceive design and act as designers. Since - as proposed by Winograd and Flores (1986) - "while designing tools, we humans design the conditions of our existence, and in turn, the conditions of our design" (Escobar, 2016, p. 128), in other words, to design new ways of being that can deconstruct the systemic unsustainability present in our world, we need to assume another worldview, oriented towards conviviality and communality.

Escobar proposes, in continuity with ontological design, autonomous design, which finds many similarities with design for transition. The author relies especially on the theories of Maturana and Varela (1995) and Heideggerian phenomenology to create a political-ontological approach to imagine paths of design practices that contribute to the defense of territories and cultures - a community's project for itself, hence autonomous design or for autonomy. Autonomous design is a proposition of radical design imagination focused on social and collective movements, where autonomy and communality are the concepts for a new way of thinking about design.

According to Escobar (2016), this new design would serve Afro-descendant, indigenous and peasant collectives, to seek the re-elaboration of new ways of knowing--being-doing that manifest the conviction that another world is truly possible. "A world where all worlds fit", the author brings the phrase from the Zapatista movement (Escobar, 2016, p. 10). Escobar uses understandings of how biology works (using the studies of Maturana and Varela) to understand autonomy as an essential characteristic for autopoiesis - the ability of the living system to self-produce.

Escobar presents, in his book "Autonomia y diseño - La Realización de lo Comunal" (2016), a theoretical case that exemplifies some premises of the proposed approach. From the context of the Cauca Valley in Colombia (Picture 3), the author analyzes the context of the region and the attempt at regional development that proved to be quite harmful to the environment and the region's population due to its "defuturing" and unsustainable conditions. And he presents perspectives that could transition the valley to a sustainable future, where the region is truly an agro-ecological bastion supported by and supporting a decentralized and multicultural network of small and medium-sized producers and villages.

**Picture 3 –** Cauca Valley – Also known as the Green Monster by black cutters, because of the immense sugarcane fields that contribute to local degeneration through deforestation, erosion of biodiversity, soil and hills, exhaustion, sedimentation and contamination of aquifers and respiratory problems due to ash produced by the periodic burning of sugarcane after cultivation.
**Source:** ESCOBAR, 2016.

The author understands co-design as fundamental to the work, that is, participatory design between collaborative organizations, which over a long period would set in motion the transition of the Cauca Valley. They would start by creating a new and radical vision for large-scale change in the region. It is important to highlight that such organizations should represent the diversity of people and social and cultural movements. The transition would begin by giving visibility to civilizational ruptures and the "defuturing" practices of the current model. It would

involve understanding the life projects of the communities and communities involved, including marginalized ones, and articulating a pluriversal bio-regional notion, going beyond the dominant popular narrative. To then propose a diversity of actions that encourage community participation in projects and construction of scenarios exploring declining, Buen Vivir, communal design (also understood as vernacular or diffuse), and new artistic expressions and means of communication that disrupt the "popular" discourse and position the new discourse in the collective imagination.

We, the authors of this article, also published Principles and Movements for Regenerative Design Processes (Garcia; Freire; Franzato; 2023). A synthesis of a theoretical-methodological approach that uses Guattari's three ecologies (the environment, social relations and subjectivities) as a design framework, and it is inspired by the most recent developments in Design for Sustainability and Regenerative Design. In this proposition we have the introduction of design modes that encourage the adoption of an ecosystemic, ecological perspective, which also relies on cartographic ethics for its mappings - which go beyond the mere representation and reproduction of realities, to promote the catalysis of movements towards healthier, fairer, more unique and supportive realities.

This proposition presents principles of regenerative practice, which are interdependent and mutually reinforcing. They can be drivers of attitudes, processes and prospective scenarios. They are: Caring and enabling the emergence of integral health; Promoting autonomy in reciprocal relationships and circular flows; Seeking co-evolution by re-signifying and developing value relationships with the ecosystem; Self-transforming from an ecosystemic point of view; Developing commonality through eco-dialogicity; and developing ecological knowledge of inter-existence. The movements of regenerative strategic design are: mapping the singularity of the organization and its place; mapping and prospecting your vocation - which would be the role of adding value to the supra and subsystems; and catalyzing the identification of capabilities and interventions that must be reinforced or developed for the organization to live its singularity and vocation. Such movements and principles aim to create conditions for the emergence of regenerative processes.

The contributions of such an approach are mainly an emphasis on acting from an ecosystemic view and the consideration of localized work that at the same time contributes with an impact/value that reverberates positively across the scales of nested systems. Also, we seek to include a look at the implication and self-transformation of the designer subject in the proposed design attitudes and modes, something that is not fully explored in the scope of Design.

Still based on Guattari's Three Ecologies, Michelin (2023) proposes Ecosystemic Design, an eco-decolonial design that aims to be located in the field of design for socio-environmental transitions. Eco-decolonial as far as it also resorts to reflection and efforts to decolonize design, seeking foundations in relational and ancestral ontologies. Like other Regenerative Design approaches, Michelin defines principles that achieve results with a positive impact on physical and social ecosystems, and encourage the creation of pluriversal futures, which consider "Nhandereko/Buen Vivir, taking into account Pacha, non-duality (multipolarity), balance and diversity." (Michelin, 2023, p. 249).

There is a notable effort in the academic design community to decolonize their cultures and ways of acting. In Brazil there is a growing appreciation of indigenous thinkers, such as Ailton Krenak and Davi Kopenawa Yanomami, and black thinkers, such as the militant 'quilombola' leader Antonio Bispo dos Santos. Such references are living examples of cultures of resistance and counter-colonization. Some designers then seek to learn and dialogue with this knowledge to reinvent their design ways in the light of a more ecological, relational and ancestral worldview. In other words, we have to learn from cultures that have not been completely "modernized". Dialogues like these can be very fruitful, like the philosophy and praxis of Brazilian educator Paulo Freire, who influenced Scandinavian Participatory Design in its emergence in the 1970s, even though this influence had been erased (Amaral; Maynart; Mazzarotto; 2022).



## 5. CONCLUSIONS

In this essay we presented the origins of modern design, through which it is possible to understand it as a type of design closely linked to the objectives and developments of industrial production. Right at this time, references such as William Morris warned about the dangers that such design could pose to society, in the context of mechanization and capitalism. Morris envisioned a utopia, which has similarities with aesthetics imagined more than a century later - utopias continue to be a designing production of resistance to hegemonic models.

In the development of the field of design at the face of socio-environmental issues, different authors proposed

other approaches, such as Papanek, Manzini and researchers/practitioners of Regenerative Design. Such approaches even inspire a redefinition of the economy towards ecological perspectives.

In this way, we start from the contextualization of modern design to contemporary proposals for a reinvention of our design modes in the light of a metaphysical and ontological change. In this context, design would no longer be just an operator of industrial and capitalist logics, to support a process of social transition that is committed to regeneration and the creation of conditions for ecosystem health.

We understand that this change is still in its starting point, although there are many inspirations that date back to ancient times. In other words, there is not just one type of design, but many, which may even precede modern industrial design. And design, as a profession and as an intentional and collective search for more regenerative realities and futures, is still developing to offer theoretical-methodological approaches oriented towards a more organic/ecological and process-based worldview.

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## REFERENCES

AMARAL, M; MAYNART, L; MAZZAROTTO, M. Paulo Freire e design participativo: contribuições, ausências e apagamentos, 14º Congresso Brasileiro de Pesquisa e Desenvolvimento em Design, Blucher Design Proceedings, Volume 10, 2022, Pages 5691-5711, ISSN 2318-6968, http://dx.doi.org/10.1016/ped2022-2554593

ARAÚJO, R. B. A concepção do trabalho na utopia libertária de William Morris. **Revista Emblemas**, Catalão, v. 1, p. 11-246, May, 2014. Available at https://periodicos.ufcat.edu.br/emblemas/article/view/35714. Last access June 14, 2023.

BRUSEKE, F. J. O problema do desenvolvimento sustentável. In: CAVALCANTI, C. (Org.). **Desenvolvimento e natureza:** Estudos para uma sociedade sustentável. Recife: INPSO/FUNDAJ, 1994. Available at: http://168.96.200.17/ar/libros/brasil/pesqui/cavalcanti.rtf. Last access in June 14, 2023.

CAPRA, F.; LUISI, P. L. **A visão sistêmica da vida:** uma concepção unificada e suas implicações filosóficas, políticas, sociais e econômicas. São Paulo: Cultrix, 2014.

CARDOSO, R. **Uma introdução à história do design.** São Paulo: Edgard Blucher, 2000.

CAVALCANTI, C. Sustentabilidade da economia: paradigmas alternativos de realização econômica in CAVALCANTI, C. (Org.). **Desenvolvimento e natureza:** Estudos para uma sociedade sustentável. Recife: INPSO/FUNDAJ, 1994. Available at: http://168.96.200.17/ar/libros/brasil/pesqui/cavalcanti.rtf. Last access in June 14, 2023.

CESCHIN, F.; GAZIULUSOY, I. Evolution of design for sustainability: from product design to design for system innovations and transitions. **Design Studies**, v. 47, p. 118-163, 2016. Available at: https://doi.org/10.1016/j.destud.2016.09.002. Last Access August 27, 2023.

ESCOBAR, A. A**utonomía y diseño.** La realización de lo comunal. Popayán: Universidad del Cauca, 2016.

FORTY, A. **Objetos de desejo:** design e sociedade desde 1750. São Paulo: Cosac Naify, 2007.

FRY, T.; DILNOT, C. e STEWART, S. D**esign and the Question of History.** Londres: Bloomsbury. 2015.

FULLERTON, J. **Capitalismo regenerativo**. Cómo los principios y patrones universales determinarán nuestra nueva economía. Bogotá: Capital Institute, Centro de Estudios para el Desarrollo Sostenible. 2015. Available at: https://www.academia.edu/35597352/CAPITALISMO_REGENERATIVO_C%C3%B3mo_los_principios_y_patrones_universales_determinar%C3%A1n_nuestra_Nueva_Econom%C3%ADa. Last access June 14, 2023.

GARCIA, N. A.; FREIRE, K. M.; FRANZATO, C. Princípios e movimentos para processos projetuais regenerativos. Mix Sustentável, v. 9, n. 2, p. 63-74, 2023. Available at: https://ojs.sites.ufsc.br/index.php/mixsustentavel/article/

view/5706. Last access Augut 7, 2023.

HARMAN, G. **Prince of Networks**: Bruno Latour and Metaphysics. Melbourne: re.press, 2009.

JAKOBSEN, O. **Transformative Ecological Economics**: Process Philosophy, Ideology and Utopia. New York: Routledge Studies in Ecological Economics, 2017.

MANG, P.; REED, B. Regenerative Development and Design. In: MEYERS, R. A. (org.). **Encyclopedia of Sustainability Science and Technology**. Springer, New York, 2012, p. 8855-8879.

MANZINI, E. **Artefactos**: Hacia una nueva ecología del ambiente artificial. Madrid, España: Celeste Ed. y Experimenta Ediciones de Diseño, 1992.

MANZINI, E. **Design para a Inovação Social e Sustentabilidade**: comunidades criativas, organizações colaborativas e novas redes projetuais. Rio de Janeiro: E-papers, 2008.

MANZINI, E. **Design quando todos fazem design**. Uma introdução ao design para a inovação social. Coordenação de tradução Luzia Araújo. São Leopoldo: Ed. UNISINOS, 2017.

MATURANA, H. R.; VARELA, F. **A árvore do conhecimento**: as bases biológicas do entendimento humano. Campinas: Psy II, 1995.

MICHELIN, C. **Design ecossistêmico: princípios teóricos e experimentos de uma abordagem regenerativa para o design**. Thesis (PhD in design) — Universidade Anhembi Morumbi, São Paulo, SP, 2023. 334f.

PEVSNER, N. **Os pioneiros do desenho moderno**: de William Morris a Walter Gropius. São Paulo: Martins Fontes, 2002.

WINOGRAD, T.; FLORES, F. **Understanding computers and cognition**: a new foundation for design. Norwood: Ablex Publishing Corporation, 1986.

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# GRAPHIC DESIGN FOR VIOLENCE PREVENTION IN A PUBLIC SCHOOL

## *DESIGN GRÁFICO PARA PREVENÇÃO DA VIOLÊNCIA EM UMA ESCOLA PÚBLICA*

## *DISEÑO GRÁFICO PARA LA PREVENCIÓN DE LA VIOLENCIA EN UNA ESCUELA PÚBLICA*

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**ABSTRACT**
This project aimed to answer the following problem-question: how could Graphic Design contribute to the prevention of violence in a public school? The object of study was a public school located in the city of Belo Horizonte, where there were cases of violence among students between 11 and 14 years old. The goal was to plan, execute and evaluate actions to prevent violence among students. The method consisted of carrying out two workshops for the production of violence prevention posters, followed by the production of an artistic intervention on the inner face of one of the school's outer walls. The results indicate that Graphic Design can contribute by creating and/or strengthening support networks for violence prevention.

**KEYWORDS**
Sustainability; 2030 Agenda; Crime Prevention; Design Against Crime; Education.

***RESUMO***
*Este trabalho destinou-se a responder a seguinte pergunta-problema: como o Design Gráfico poderia contribuir para a prevenção da violência em uma escola pública? O objeto de estudo foi uma instituição de ensino pública, de nível fundamental, situada no município de Belo Horizonte, na qual havia casos de violência entre os estudantes de 11 a 14 anos. O objetivo foi planejar, executar e avaliar ações para prevenção da violência entre os aprendizes. O método foi a realização de duas oficinas de produção de cartazes para a prevenção da violência, as quais foram seguidas pela elaboração de uma intervenção artística na face interna de um dos muros da escola. Os resultados apontam que o Design Gráfico pode contribuir criando e/ou fortalecendo as redes de apoio para prevenção da violência.*

***PALAVRAS-CHAVE***
*Sustentabilidade; Agenda 2030; Prevenção do Crime; Design Contra o Crime; Educação.*

***RESUMEN***
*Este trabajo tuvo como objetivo responder a la siguiente pregunta problemática: ¿cómo podría el Diseño Gráfico contribuir a la prevención de la violencia en una escuela pública? El objeto de estudio fue una institución de educación pública, de nivel elemental, ubicada en la ciudad de Belo Horizonte, en la que se presentaron casos de violencia entre estudiantes de 11 a 14 años. El objetivo fue planificar, ejecutar y evaluar acciones para prevenir la violencia entre aprendices. El método consistió en realizar dos talleres de producción de carteles para prevenir la violencia, a los que*



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*siguió la creación de una intervención artística en el interior de una de las paredes de la escuela. Los resultados indican que el Diseño Gráfico puede contribuir a crear y/o fortalecer redes de apoyo para la prevención de la violencia.*

***PALABRAS CLAVE***
*Sostenibilidad; Agenda 2030; Prevención del crimen; Diseño Contra el Crimen; Educación.*

## 1. INTRODUCTION

Unfortunately, acts of violence happen frequently in Brazilian public schools. Silva and Negreiros (2020) produced a systematic review of papers produced between 2014 and 2018 about acts of violence in public schools in the country. The authors concluded that school violence is present across all demographics and may occur physically or verbally. According to AGÊNCIA SENADO (2022), during a public hearing of the Education Commission, specialists stated that the increase in cases of assault in schools is a serious challenge for Brazil. The prevention of violence in developing countries is established in Sustainable Development Goal 16, Peace, Justice and Strong Institutions, further detailed on target 16.a (UNITED NATIONS, [2023?]).

> 16.a Strengthen relevant national institutions, including through international cooperation, for building capacity at all levels, in particular i*n developing countries*, to *prevent violence* and combat terrorism and crime. (UNITED NATIONS, [2023?], highlights ours).

According to Castelli (2008), preventing minor infractions does not necessarily require the presence of security agents. As such, design can contribute by building a culture of prevention.

For decades, researchers in English-speaking countries have studied the Design Against Crime approach, especially the Design Against Crime Research Lab, affiliated with the University of the Arts London (UAL), in the United Kingdom.

Thus, we built the problem-question of this article: how could Graphic Design contribute to the prevention of violence in a public school? The objective was to plan, execute and evaluate actions aimed at preventing acts of violence among students.

## 2. DESIGN AND SOCIETY

Industrialization, urbanization and globalization have driven the historical evolution of Design and its separation from manual practices, such as craftwork. In the nineteenth century, there was the professionalization of design, especially in the textile industry, following the division of labor in the Industrial Revolution. Consequently, design schools emerged in the twentieth century, establishing design as an important activity for organizing and interfacing with a complex and interconnected world (CARDOSO, 2008).

Bonsiepe (1997) states that, generally, society associates Design mainly to the ability to draw. That is, in regard to industrial production, the designer appears as a make-up specialist. This idea connects Design to something superficial and not very relevant or rigorous.

> This diagram consists of three fields, united by a *central category*.
>
> First - there is a user or social agent who wants to execute an effective action.
>
> Second - there is a task that the user wants to complete, for example: cutting bread, applying lipstick, listening to music, drinking beer, or opening a root canal.
>
> Third - there is a tool or artifact that the user needs to effectively execute the action - a knife, a tube of lipstick, a walkman, a glass, a 20,000 rpm high-speed precision turbine.
>
> Here lies the question: how can these three *heterogenous* fields - a body, an objective and a tool, or a piece of information when it comes to communicative action (we draw a distinction between instrumental action, or the use of products, and communicative action, or the use of signs/information) - be attached to one another? Well, the attachment between these three fields happens through the interface. We must take into account that the interface is not a thing, but the space in which the interaction between body, tool (object or sign) and objective of the action is structured. This is precisely the central area of design (BONSIEPE, 1997).

Therefore, the interface is the central theme of Design, the main interest of which is sociocultural efficiency in daily life (BONSIEPE, 1997). In his book, *Design para um mundo complexo* (Design for a Complex World), Cardoso (2012) proposes that each person's part is to understand their part in the whole, considering the interconnectivity that is present in the modern world.

Analogously, the designer Victor Papanek, through his book *Design para um Mundo Real* (Design for a Real World, published in 1971), addressed the direct relationship between Design and the problems of daily life, highlighting poverty, exploitation and violence (CARDOSO, 2012).

## 3. DESIGN AND CRIME PREVENTION

Silva *et al*. (2018) present a definition for the expression design against crime.

> The *design against crime* approach uses design as a tool for changing the perception of the benefit of the crime as identified by the offender, acting to develop products, services and environments as a form of prevention (SILVA et al. 2018, p.17, highlights of authors).

In the United Kingdom, Lorraine Gamman has led the Design Against Crime Research Lab for over 25 years, through which she and her team have approached crime (and other social issues) through the usage of Design tools (GAMMAN, 2022).

Gamman (2022) classifies the evolution of Design Against Crime in four stages. At the first level, the lowest-complexity one, the focus is on traditional design, aimed at products and brands. On the second stage, in turn, the focus is on services and experiences, and, much like the first stage, it focuses on differentiation. On these two stages, the approach is user-centric and the results are more tangible than on the following levels. On the third stage, the focus is on creating meanings and, at this point, Design Against Crime becomes participatory. Finally, the fourth stage, the highest-complexity one, is defined by a focus on promoting change, with maximal intangibility. At this level, Design Against Crime becomes collaborative.

The research center led by Lorraine Gamman promoted several initiatives that correlated empathy and crime prevention. Gamman (2016) states that empathy can support the establishment of communities, as a counterpoint to individualism. Furthermore, the researcher defends that empathy helps in the practice of negotiation, which is fundamental for conflict resolution between people.

Krznaric (2016), in turn, mentions the artistic intervention A Mile in My Shoes. It consists of the installation of a shoebox-shaped room in a public place. In this space, visitors find a few pairs of shoes, each one next to an iPod Shuffle with headphones, and each device tells someone's story. As such, visitors are invited to listen to the story and imagine what they would think and feel if they were in that situation. According to Nunes (2017), Krznaric's artistic intervention came to Brazil in 2017 and took place at Ibirapuera Park, in the city of São Paulo.

In Brazil, Instituto Promundo freely distributes the booklet *Cuidar sem violência: todo mundo pode!* (Caring without violence, everyone can!). It describes various activities that can be done with families or communities, with the aim of reducing violence. About the booklet, INSTITUTO PROMUNDO (2003) states that:

> The objective of this publication is to contribute to the discussion of positive, violence-free education alternatives for children, even in communities that are considered violent (INSTITUTO PROMUNDO, 2003, p.5).

## 4. DESIGN, COMMUNICATION AND SOCIAL CHANGE

### 4.1 Graphic Design and Activism

Albuquerque (2018) studied protest signs, particularly those produced in twentieth-century social protests, which became symbols of resistance and expression. Many of them were produced anonymously and distributed to interested parties. For example, in the 1980s, the gay and lesbian communities produced various types of print materials, to spread educational messages about safe sex, as well as warn about the spread of the AIDS virus.

Therefore, during the 1970s and 1980s, there was an intensification of activist design. "Grupus" (in France) and the punk movement (in the United Kingdom) were groups of people that produced a series of fanzines to spread their ideas, using graphic design as a form of expression and protest. It was also during this time that other graphic artists, such as Jean-Michel Basquiat, instigated discussions about social issues and shared their thoughts on the streets, turning walls into protest signs (ALBUQUERQUE, 2018).

According to Albuquerque (2018), design and activism are historically intertwined, working as powerful vehicles for communicating political and social messages. In response to modern challenges, design became a key element in civil rights movements, using both print media (such as signs and leaflets) and new digital platforms. These design tools are crucial for spreading messages and bolstering actions for a more equitable world, translating the aspirations and needs of marginalized groups into images and actions.

### 4.2 Typography in Minas Gerais, Brazil

Rodrigues (2015) describes typography as a means of transmitting information. This technology was created in Mainz, in what is now Germany, in the mid-fifteenth century, by Johannes Gutenberg, who invented the movable type. Rather than carving into one material the entire text of a page, Gutenberg realized that he could mold letters so that they could form any word. These letter and graphic sign molds could be moved to make new pages. Thus, movable type allowed for endless new publications, initially in Europe, establishing a new paradigm of access to information and spread of knowledge.

According to Nave (2014), in 1473, typography reached the Netherlands, one of the most prosperous regions of Europe at the time. However, few workshops managed to have the quality and capital needed to commercialize their works. We can highlight the Platinian workshop, in Antwerp, as the main company that reached international fame, due to its quality and ability to spread its prints and engravings throughout the world, including the Hispanic and Iberian empires and their colonies.

> In the late fifteenth century, the city of Antwerp had become the first commercial center of Northwest Europe, at a time of unmatched splendor, where luxury object and art ateliers bloomed, and among them, the press. Indeed, typography was a great capitalist enterprise that could be developed thanks to the flow of capital, the international character of the market and a solid distribution network. (NAVE, 2014, p. 31).

Antwerpian booksellers sold their books in Spain and Portugal, due to the meager typographical production in these countries (NAVE, 2014). However, according to Bohrer (2014), during Portuguese rule, typographical production was forbidden in Brazil: no books could be published in Portuguese territories in America. There was an explicit concern with avoiding the propagation of heretical or revolutionary books, in both the Portuguese mainland and its colonies.

> In the 300 years of prohibition of typography in Brazil – aside from brief initiatives – book circulation was monitored, to greater or lesser success, by the ruling censorial bodies in Portugal. The – brief – initiatives refer essentially to: alleged Dutch printing press, in the time of Nassau; printing press in Recife, in 1706; typographical workshop in Rio de Janeiro's jesuit school (1724); Antônio Isidoro da Fonseca's printing press, in 1747, equally in the city of Rio de Janeiro, Gomes Freire de Andrada's, and the calcographic press of Father José Joaquim Viegas de Menezes, in Vila Rica do Ouro Preto, in the year 1807. (IPANEMA; IPANEMA, 2007, p. 15-16).

Analogously, Mendes (2005) states that Brazilian typography did not begin in the state that is now called Minas Gerais (where the city of Ouro Preto, previously called Vila Rica do Ouro Preto, is located). However, according to Araújo (2008), in this state, typography occurred in a transgressive and unusual fashion.

> Curiously, the history of the press in Minas begins with an act of rebellion by the captaincy's ultimate authority itself, in 1807, that is, a year before the arrival of the Portuguese Royal Family and the creation of the Royal Press, in Rio de Janeiro. The first work printed in Minas Gerais came under the auspices of then-Governor Pedro Maria Xavier de Ataíde e Mello, who, wanting to see the laudatory poem that Diogo Pereira de Vasconcelos dedicated to him published, took responsibility for infringing the royal order of July 6, 1747, that strictly forbade any press activity in Brazil. Such an undertaking was only possible thanks to the priest, artist and printer José Joaquim Viegas de Menezes. (ARAÚJO, 2008, p. 20).

At this time, specifically in the year 1820, Manoel José Barbosa Pimenta e Sal, a Portuguese man, lived in Vila Rica do Ouro Preto. He worked as a hatter and silk spinner, and was very talented in mechanics. Even though he quite liked to read, the hatter did not understand the central book in his shelf, possibly an Arts and Sciences dictionary, written in French. Barbosa leafed through and looked at the illustrations in the book without understanding the words, but he carefully observed the drawings of typographic equipment. So Father José Joaquim Viegas de Menezes, who understood the French language, translated this text for the hatter, as well as explaining how a printing press worked and what it consisted of. Barbosa and Viegas became friends and decided to build a printing press, which was finished in 1821. Then, Viegas asked that Barbosa take care of the enterprise and, on 20th April 1822, the typographical workshop obtained a

permit to work. There the first newspapers of the state would be printed: *Compilador Mineiro* started in 1823; *Abelha do Itaculumy* started in 1824; *Universal* started in 1825; *Companheiro do Conselho* started in 1825 and *Diário do Conselho started in* 1825. The director of the first newspaper in the state (*Compilador Mineiro*) was Father Viegas (ARAÚJO, 2008).

> Regardless of the invaluable aid of the erudite priest, the emergence of the moving-type press, of typography, must be attributed to the inventive Manoel José Barbosa, a practical mechanic, who, through his own effort, both in manufacturing the letters and the machine and in qualifying composers and apprentices, started *Tipografia Patrícia de Barbosa & Cia.*, which was responsible not just for the publication of the first Minas Gerais newspapers, but that of books as well. It is important to note that, even though it was built in 1821, in what was then Vila Rica, Barbosa's printing company only obtained a work permit from prince regent D. Pedro on April 20, 1822. [...] making Manoel Barbosa's *Tipografia Patrícia* the only printing company in the state for a while. It is no coincidence that the first newspapers, of varied and even opposing political views, were printed there (ARAÚJO, 2008, p. 20, highlights ours).
>
> So began, in a rudimentary and subservient manner, the Minas Gerais press. Twenty years after this first print adventure, the art of printing was still small-scale and elementary in the state of Minas Gerais. However, unlike that world from the time of the captaincy, the state registered another use for the press. It was no longer praise for the government that set the tone at the workshops. It was, in fact, criticism and dispute that occupied printers in the last years of the First Reign. The heat of the moment drove the creation of various printers in distant parts of Minas (MOREIRA, 2008, p. 26).

Thus, in Minas Gerais, typography registered the transformations of local society from the first half of the eighteenth century to the twentieth century, through various newspapers, journals, advertisements and poems (MOREIRA, 2008).

## 5. METHODS

This project was designed and applied by a volunteer Graphic Design undergraduate student, supervised by two researcher-professors, one of which supervised him directly and the other directed the project. The student sought out the professors looking for undergraduate research opportunities and was introduced into an ongoing project dedicated to crime prevention in public schools through Industrial Design and Interior Design (developed by two students in those courses). The student liked the project and decided to contribute with a Graphic Design approach. The object of study was a public school, with students aged 6 to 14 years old, in the city of Belo Horizonte (capital of the state of Minas Gerais), where there were cases of violence among the students, particularly in the 11-14 age range. The name and address of the school were left out of this article for ethical reasons.

Initially, the student read texts about Design Against Crime, with the works of INSTITUTO PROMUNDO (2003) and Gamman (2022) as the two main references. Then, he, along with the academic advisor and the Industrial Design student, visited the school twice, once in the morning and once in the afternoon, which are the two shifts at the school. On those occasions, the student observed both the physical space and people's behavior. At the end of the second visit, the academic advisor and the two students discussed potential actions to prevent crime at the school. At this meeting, the Graphic Design student mentioned the possibility of building a partnership with the researcher-professor who leads the university's typography lab, an idea that was later accepted by the professors responsible for the project. Thus, he contacted the typography researcher-professor, who accepted the invitation.

Then, the Graphic Design student wrote the first version of the action plan. It was discussed with the academic advisor, who suggested improvements. Then, they scheduled a meeting to debate the proposal with the partner professor, who also proposed improvements to the text. Adjustments made, the plan of action was sent to the administration of the object of study school for prior reading. On October 18, 2022, there was a meeting at the school, attended by the school's principal, its vice-principal, its director of pedagogy, the civil servant responsible for its security, the academic advisor, the Graphic Design student and the Industrial Design student. At this meeting, the school employees

suggested improvements to the project, to better suit it to local particularities.

At the suggestion of school administration, students in later grades (children between 11 and 14 years old) were chosen as the target audience of the actions, because it was within this group that most acts of violence occurred. The vice-principal suggested choosing two students from each class, one with what is considered exemplary behavior and one with behavior that is classified as inadequate. However, the students would not be informed of the selection criteria. This was necessary because the administrators feared that students would not come to activities outside the usual schedule, and our proposal should not overly impact regular teaching. We assumed that the two students chosen could influence their respective groups, both the group with good behavior and the group with bad behavior. Furthermore, we inferred that fostering friendly contact between these two different students would promote the establishment of peace and dialogue between the students of each class. The principal also mentioned the possibility of integration with another project at the school. At the end of our actions, she would invite a graffiti artist to decorate the inner face of one of the school's outer walls along with the students. The artwork would be based on the material produced by the students during our actions.

The action plan included two workshops. The first sought to promote reflection and empathic rapport between the students, as well as stimulate them to recognize both the violence they suffered and that which they inflicted. The workshop would consist of the production of signs by the students, with phrases created by them about the types of violence they identified. At this stage, the Graphic Design student would help the children, teaching them to use graphic design tools such as: composition rules, usage of colors and hierarchic organization of information. The signs could be intended to warn, inform, sensitize or do activism. The second workshop's goal was to stimulate collective and affective memory to prevent violence at school. We assumed that the use of typographic printing at this stage would make the participants curious, as it is a little-known procedure in the present day. Furthermore, the workshop would show the historical importance of typography in the construction and spread of ideas in Minas Gerais. As such, we aimed to connect past and present, creating identification both between participants and between them and the state they are a part of, as well as encouraging the children to seek new forms of expression.

As such, on November 22, 2022, at around 10 a.m., the first workshop began, lasting approximately 1 hour and 40 minutes. The Graphic Design student, the academic advisor, the vice-principal and approximately 30 children were present. First, the university student introduced the researchers, the university, the research centers involved and the proposal. Then, he asked the students to introduce themselves.

Next, he ran an activity called Words of Violence. Arranged in a large circle, each student was given two pieces of blank paper. In one, they were asked to write one type of violence they had suffered. We would have liked each student to comment on the word they chose. However, as participants were somewhat embarrassed, this procedure was quickly aborted. Then, the papers were put away in a colored bag. Next, the students proceeded similarly with the second piece of paper, but writing a type of violence they had inflicted on someone on it. These papers were put away in another colored bag.

Then, the Graphic Design student showed the children the song Mlk 4tr3v1d0 by rapper Djonga. He highlighted how the artist spoke the words to share a message about respect. Respect for the origins of rap, respect for the relevance of this rhythm in the culture of poorer communities and using respect to resist racism (racism that Djonga, as a black man, may also be targeted by).



On the next step, the university student showed the children some signs made with typographic printing, so that they understood what would be done at the second workshop. Then, we then formed 8 groups, with approximately 4 students each. Each group drew one word from each colored bag and, with those two words, the team should create one or more phrases about preventing violence at school. With their phrase, each team should make a draft sign that would serve as a base for the production of typographically printed signs, which would be made at the next meeting.

We instructed the students to consider the school community as the target audience of their signs. While producing the sentences, we spoke directly with the students of each team, to help with both the graphic art and the reflection about what message each group would like to share. For this activity, white bond paper, pencils, erasers and markers in various colors were made available to the participants.

After collecting the signs made by the students in the first workshop, the Graphic Design student went to the university's typography lab and, with due supervision by the partner researcher-professor, selected the movable

types (letters in metallic material) and joined them, creating the matrices for typographic printing (Figure 01). As time for the second workshop would be short, it was necessary to choose some of the phrases, in order to bring the material to the school already set up.

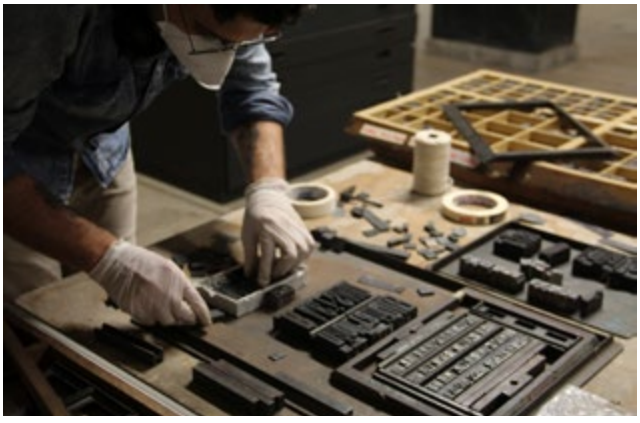

**Figure 01:** Undergraduate student setting up typographic matrix.
**Source:** Authors.

On December 7, 2022, at 10 a.m., we started the second workshop, lasting approximately 1 hour and 40 minutes. There were 30 students present, as well as the university student, the academic advisor, the vice-principal and the partner researcher-professor. We transported two typographic presses from the university's typography lab and installed them in a room at the school. We also brought paper, ink and an ink roller suited for performing the manual printing for the students. There is a type of ink specific for typographic printing and, on that occasion, the only color available was dark green. However, there was color paper, as well as gouache paint and markers so that students could perform artistic interventions on their signs after printing. We also brought a guillotine to cut the paper.

First, the partner professor briefly explained the history of typographic printing in Minas Gerais, mentioning its origins in the city of Ouro Preto and its importance as a movement to combat limitations imposed by Portugal. He also highlighted the importance of information and memory, and the role of visual communication as a way of reflecting and sharing ideas. Next, he presented the typographic presses, the moving type and the print matrices to the students.

Then, he taught the children manual printing, with appropriate safety measures. The students quickly grasped the procedure and printed several signs. After printing, some participants made artistic interventions on the signs produced. Once activities were over, the partner researcher-professor took the equipment back to the university's typography lab.

On May 22, 2023, at 10 a.m., the academic advisor met with the vice-principal at the school, to evaluate the workshops and their impact on violence prevention. Unfortunately, it was not possible to speak with the principal, because she had been transferred to another school. During the meeting, the two women spoke informally, as the academic advisor tried to make the vice-principal feel free to express her opinions. On the same day a short (paper) questionnaire was given to be anonymously and voluntarily filled by the students who participated in the workshop. The form had 6 multiple choice questions and 2 essay questions. The vice-principal was responsible for distributing the questionnaires, though she warned that she would not be able to get answers from all participants, as some had left the school. Among the main reasons for the absence of these students was removal from the institution for bad behavior and graduation from the last year of middle school. We obtained 13 filled forms, that is, answers from 43% of the workshop participants. At the time, the graffiti on the inner face of the school's outer wall had been concluded, which was done by workshop participants supervised by artists Thiago Ocelli Biaggio (Destro) and Luísa Santos. On June 12, 2023, the academic advisor went to the school to collect the filled questionnaires and subsequently did data treatment and analysis.

## 6. RESULTS

The first meeting was an important moment to create affective bonds between ourselves and the students, and between the students and each other. Having dispelled the initial mistrust and resistance, the students were very participative. Figure 02 shows signs being produced by students during the first meeting.

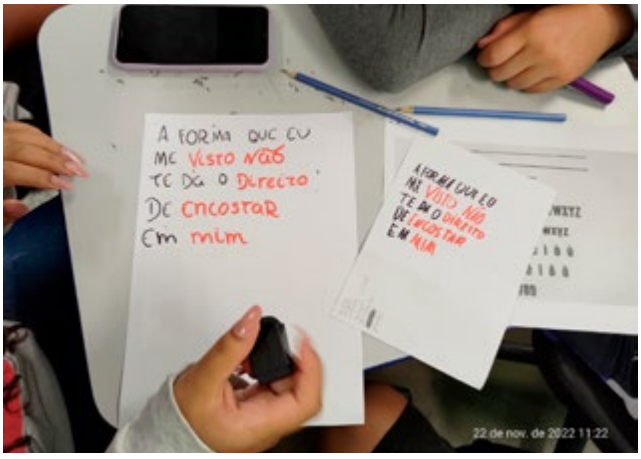


**Figure 02:** Draft of a sign that reads "*A forma que eu me visto não te dá o direito de encostar em mim*", meaning "The way I dress does not give you the right to touch me".
**Source:** Authors.

On the second day, participants produced several signs and not just the minimum of one per group, therefore, we conclude that they were excited about the proposal. Figure 03 shows one of the students' productions.


**Figure 03:** Typographic print with artistic intervention produced by a student, with the phrase "*A forma que eu me visto não te dá o direito de encostar em mim*", meaning "The way I dress does not give you the right to touch me".
**Source:** Authors.

In turn, Figure 04 shows part of the graffiti produced by workshop participants under supervision of artists Thiago Ocelli Biaggio (Destro) and Luísa Santos.


**Figure 04:** Part of the graffiti on the inner face of the school's outer wall, with the phrase "*Se fere a minha existência, serei resistência*", meaning "If it harms my existence, I will be resistance".
**Source:** Authors.

About the results obtained from the questionnaires, we note that the answers represent mostly the opinion of the group of students with good behavior. When questioned about what they were feeling minutes before the first workshop, 46% of respondents claimed to be feeling curious, 31% said they were excited, 15% mentioned feeling lazy and 8% claimed to be scared. However, when questioned about their feelings immediately after the final workshop, 31% were curious, 54% were excited, 15% felt lazy and nobody marked the scared option. We note, then, an increase in the percentage of excited students, as well as a decrease in curious and scared students.

However, according to most respondents there was no change in the school's violence after the workshop (54%), though 46% believed that violence decreased. No student indicated there was an increase in violence. When asked about changes within themselves after the meetings, most (58%) claimed there was a change. Among those that claimed there was a change, 14% claimed to want to know more about the topic, 14% claimed it reaffirmed the importance of interrupting violence in them and 71% showed that they reflected on the topic and/or changed their behavior. Additionally, 57% of these responses indicated empathy and non-hostile combatting of violence. One student claimed to have lost the fear of protesting, as well as having learned to fight racism with words.

When asked for suggestions on improvements for new workshops in the future, we noted a desire for further development of the theme and for activities with more social interaction. One of the respondents wished to discuss possible actions when witnessing an assault.

At the meeting on May 2, 2023, the vice-principal claimed to have noticed a reduction of violence among the students, which she attributed to two synergetic factors. According to her, once cases of violence were

identified, the guardians of the students considered to be offenders (usually their mothers) were called to the school, however, often these adults did not respond to these summons. In those cases, the principal's office informed the Guardianship Council of what happened. However, there was usually no significant response from the institution. Yet in 2022, when the workshops happened, the councilors supported the school more effectively, paying home visits to those mothers. In spite of that, even after those visits, there were those who would not answer the school administration's summons. In that case, the councilors notified them to go to the school, but in order to have their children transferred to another institution. According to the vice-principal, in those cases, the school does not recommend the student to another establishment, with their guardian being responsible for finding a spot at another school. The administrator also noted the importance of the actions of two newcomer supervisors, who barred entry to students whose notified guardians had failed to appear at the school. According to the interviewee, this showed the students considered delinquents that their actions had consequences. Therefore, according to the vice-principal, the immediate result of the Guardianship Council actions was the removal of many of the offending students, which weakened the groups of students with bad behavior.



When questioned on whether transferring the violent students would be simply transferring the problem to another school, the administrator disagreed. She informed us that, previously, the school had traded one violent student for another, from another institution, which reduced the amount of infractions. According to her, aggressive students, when coming to an unknown school, feel somewhat uncomfortable breaking the rules, as they have lost the support of the groups they belonged to at their original schools.

The second factor that reduced violence among students, according to her, was a change in attitude of the students considered to have good behavior. After the workshops, they felt stronger and began to pressure the few offenders that remained, in cases where they could be unfairly punished. As an example, the administrator mentioned an episode of theft of pens in a classroom. At the time, she was called, and informed the class that, while the stolen pens were not returned, nobody would go home. Then, she heard some children complaining and, a few minutes later, the pens appeared in a corner of the room. The vice-principal connected the workshop to this new attitude of the students with good behavior.

## 7. FINAL COMMENTS

This project sought to answer the following problem-question: how could Graphic Design contribute to the prevention of violence in a public school? The results indicate that Graphic Design can contribute by creating and/or strengthening support networks for the prevention of violence. The project encouraged reflection and new behaviors in the school community, fighting fear and apathy. At first, we built a support network between the researchers themselves and the school administration. Then, the school administration strengthened its bond with the Guardianship Council. And, finally, bonds were strengthened between the students themselves, who felt empowered to rise against violence, be it with words or new behaviors.

## REFERENCES

AGÊNCIA SENADO. **Violence in schools: specialists reinforce the importance of welcoming students.** Brasília, 8 Jun. 2022. News from the Senate website. Available at: https://www12.senado.leg.br/noticias/materias/2022/06/08/violencia-nas-escolas-especialistas-reforcam-importancia-de-acolhimento-de-estudantes . Accessed 02 May 2023.

ALBUQUERQUE, E. M. A. **Design gráfico em tempos de ativismo.** 2018. Dissertation (Master's degree in Design) - Center for Arts and Communication, Federal University of Pernambuco, Recife, 2018. Available at: https://repositorio.ufpe.br/handle/123456789/34595 . Accessed 12 Dec. 2023.

ARAÚJO, M. M. Uma história de precursores e ativistas. **Revista do Arquivo Público Mineiro**, Belo Horizonte, v.44, n. 1, p.18-23, 2008. Available at: http://www.siaapm.cultura.mg.gov.br/modules/rapm/brtacervo.php?cid=1051&op=1 . Accessed 15 Dec. 2023.

BOHRER, A. Os missais de Plantin e outras reminiscências flamengas no barroco mineiro. In: THOMAS, W.; STOLS, E.; KANTOR, I.; FURTADO, J. (org.). **Um Mundo Sobre Papel: Livros, Gravuras e Impressos Flamengos nos Impérios Português e Espanhol.** São Paulo: Edusp, 2014. p.475-458.

BONSIEPE, G. **Design: do material ao digital.** 1. ed. Florianópolis: Blucher, 1997.

CARDOSO, R. **Uma introdução à história do Design.** 3. ed. São Paulo: Blucher, 2008.

_____. **Design para um mundo complexo.** São Paulo: Cosac Naify, 2012.

CASTELLI, A. V. Design Contra o Crime: uma oportunidade para a indústria do Paraná. In: BONDARUK, R. L. **Design Contra o Crime: Prevenção Situacional do Delito através do Design de Produto.** Curitiba: FIEP, 2008.

GAMMAN, L.**Why Focus on Empathy?** [S.l.], 15 Feb. 2016. 1 video (35min52s). Video-recorded presentation available at the Design Against Crime Youtube channel. Available at: https://www.youtube.com/watch?v=0wXgjcY3C8o&t=1370s . Accessed 24 May 2023.

_____. **Reviewing "Safer Streets": History, Theory and Practice + New Design Directions for Social Designers regarding VAWG.** [S.l.], 24 Feb. 2022. BAPD presentation in support of the Clear Channel Client Project Brief. Received by email on 28 Mar. 2022.

INSTITUTO PROMUNDO. **Cuidar sem violência, todo mundo pode!** Rio de Janeiro: Instituto Promundo, 2003. Available at: https://promundo.org.br/recursos/cuidar-sem-violencia-todo-mundo-pode/ . Accessed 24 May 2023.

IPANEMA, C., IPANEMA, M. S**ilva Porto: livreiro na corte de D. João, editor na independência.** Rio de Janeiro: Capivara, 2007.

KRZNARIC, R. **Empathy Low Res.** [S.l.], 10 May 2016. 1 video (1h27min50s). Video-recorded presentation available at the Design Against Crime Youtube channel. Available at: https://www.youtube.com/watch?-v=j7TwpvSiQ58&t=148s . Accessed 10 Mar. 2023.

MENDES, J. F.. Memória dos Jornais Mineiros no século XIX. In: ENCONTRO NACIONAL DA REDE ALFREDO DE CARVALHO, 3., 2005, Novo Hamburgo. **Anais** [...]. Novo Hamburgo: ALCAR, 2005, p. 13-28.

MOREIRA, L.S. Combates tipográficos. R**evista do Arquivo Público Mineiro**, Belo Horizonte, v.44, n.1, p.24-41, 2008. Available at: http://www.siaapm.cultura.mg.gov.br/modules/rapm/brtacervo.php?cid=1053&op=1 . Accessed 28 Dec. 2023.

NAVE, F. Antuérpia como Centro Tipográfico do Mundo Ibérico (Séculos XVI-XVIII). In: THOMAS, W.; STOLS, E.; KANTOR, I.; FURTADO, J. (org.). **Um Mundo Sobre Papel: Livros, Gravuras e Impressos Flamengos nos Impérios Português e Espanhol.** São Paulo: Edusp, 2014. p.30-42.

NUNES, M. **"Museum of Empathy" Arrives in São Paulo: put yourself in the place of the other wearing your shoes** [S.l.], 13 Nov. 2017. News on the website Conexão Planeta. Available at: https://conexaoplaneta.com.br/blog/museu-da-empatia-chega-a-sao#paulo-coloque-se-no-lugar-do-outro-calcando-seus-sapatos/ . Accessed 20 Mar. 2023.

RODRIGUES, C. S. **Design aplicado às tecnologias de rede colaborativa: projeto para a difusão da memória coletiva da tipografia em Minas Gerais**. 2015. Dissertation (Master's degree in Design) - School of Design, State University of Minas Gerais, Belo Horizonte, 2015. Available at: https://mestrados.uemg.br/ppgd-producao/dissertacoes-ppgd/category/83-2015?download=244:design-aplicado-as-tecnologias-de-rede-colaborativa-projeto-para-difusao-da-memoria-coletiva-da-tipografia-em-minas-gerais. Accessed 01 Dec. 2023.

SILVA, E. H. B.; NEGREIROS, F. Violência nas escolas públicas brasileiras: uma revisão sistemática da literatura. **Revista da Associação Brasileira de Psicopedagogia**, São Paulo, v. 37, n.114, p. 327-340, 2020. Available at: https://www.revistapsicopedagogia.com.br/detalhes/647/violencia-nas-escolas-publicas-brasileiras--uma-revisao-sistematica-da-literatura . Accessed 02 May 2023.

SILVA, G. C.; DA ROSA, P.C.; FRAGA, P.G.R. BERNARDES, M.M.S. BRUSCATO, U. M.TONETTO, L.VAN DER LINDEN, J.C.S. Design Contra o Crime: as diversas formações do pesquisador atuante na área. In: VAN DER LINDEN, J. C. S. BRUSCATO, U. M.; BERNARDES, M.M.S. (Orgs.). **Design em Pesquisa**, vol. 12, Porto Alegre: Marcavisual, 2018. p 17-32. Available at: https://lume.ufrgs.br/handle/10183/178699 . Accessed 29 Dec. 2023.

UNITED NATIONS. **Goal 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective,**

**accountable and inclusive institutions at all levels**. [S.l.], [2023?]. Website publication. Available at: https://sdgs.un.org/goals/goal16#targets_and_indicators . Accessed 14 Jan. 2024.

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# CREATIVITY AND BIOINSPIRATION AS A BASIS FOR INNOVATION IN SURFACE DESIGN

## *CRIATIVIDADE E BIOINSPIRAÇÃO COMO BASE PARA INOVAÇÃO EM DESIGN DE SUPERFÍCIE*

## *CREATIVIDAD Y BIOINSPIRACIÓN COMO BASE PARA LA INNOVACIÓN EN DISEÑO DE SUPERFÍCIES*

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**ABSTRACT**
Currently, the use of varied methods for Teaching Design and for projecting has gained breadth, and as a result, there are more and more methods and variations in methods for teaching design and for designing products and services on the market. The union of methods is also widely used as a basis for ideating design concepts, thus adding more access to innovation and emotion to objects. The objective of this review is to survey and at the same time make a connection about Creativity, Innovation, Bioinspiration and Surface Design. This review work is the first phase of a broad post-doctoral research on Bioinspiration and the creative phase of Product development.

**KEYWORDS**
Review; Design; Methods.

***RESUMO***
*Atualmente, o uso de métodos variados para o ensino de Design e para projetos tem se ampliado, e, como resultado, há cada vez mais métodos e variações de métodos para o ensino de design e para a concepção de produtos e serviços no mercado. A união de métodos também é amplamente utilizada como base para a criação de conceitos de design, adicionando assim mais acesso à inovação e emoção aos objetos. O objetivo desta revisão é fazer um levantamento e ao mesmo tempo estabelecer uma conexão sobre Criatividade, Inovação, Bioinspiração e Design de Superfície. Este trabalho de revisão é a primeira fase de uma ampla pesquisa de pós-doutorado sobre Bioinspiração e a fase criativa do desenvolvimento de produtos.*

***PALAVRAS-CHAVE***
*Revisão; Design; Métodos.*

***RESUMEN***
*Actualmente, el uso de métodos variados para la enseñanza del Diseño y para la proyección ha ganado amplitud, y como resultado, hay cada vez más métodos y variaciones de métodos para la enseñanza del diseño y para el diseño de productos y servicios en el mercado. La unión de métodos también se utiliza ampliamente como base para idear conceptos de diseño, añadiendo así más acceso a la innovación y emoción a los objetos. El objetivo de esta revisión es hacer un levantamiento y al mismo tiempo establecer una conexión sobre Creatividad, Innovación, Bioinspiración y Diseño de Superficies. Este trabajo de revisión es la primera fase de una amplia investigación postdoctoral sobre Bioinspiración y la fase creativa del desarrollo de productos.*



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***PALABRAS CLAVE***
*Revisión; Diseño; Métodos.*

## 1. INTRODUCTION

Design as a function is essentially design and planning. Compliance with the development and project stages needs to be well defined methodologically and this is passed on both in teaching and in the job market. Understanding the problem, establishing a method and developing the product effectively depends on the commitment and quality in executing these steps. When teaching design, the methods and development stages are essential for learning and successful project execution in the market by the designer. The result of design as a product or service has served humanity in surprising ways that until recently were unimaginable. The use of design as an innovation tool is undoubtedly the key point for maintaining human activities, conserving the planet, communication, use of new materials, teaching, science and technology. Design goes hand in hand with development and innovation. Although innovation is the result of product development along with its success in the market, its attributes are tools for maintaining companies in the economy of a city, state, country or even the world. It is through the innovative company, product or service that companies remain competitive and collaborative in the eyes of consumers. Therefore, innovation is dependent on the adopted model of creativity, approach and systemic vision of its developers towards a possible successful product or service (Kotler, 2011). In design teaching, this preliminary project phase has its importance focused on the study of methods. This understanding offers the student a creative framework at the time of development. Data collection is the interface between understanding the problem and developing the product itself. Data collection must follow a series of procedures that range from interviews with users, user habits, product function, product ergonomics, blueprint analysis, image panels, semantics, product dimensions, in short, structured information for the purpose of know the product to be developed, the opportunity and the user. (Baxter, 1998). The creativity phase is specifically one of the key points for innovation and the center of the objective of this research. The ideation phase is the essential phase of the design activity. It is at this stage that some design capabilities are put to the test. Design, spatial vision, creativity, materials and processes, systems, sustainability, ergonomics are important areas of knowledge for the designer's repertoire in ideation - precisely because the brain will make as many connections as possible in order to solve the problem and expose the possible solution through sketches and later advanced drawings or even temporary modeling. "Creativity is the heart of design, at all stages of the project" (BAXTER, 1998, p.85). Therefore, the methods attributed to the creativity phase and the theoretical, practical and empirical framework of the designer and project student will dictate the level of possibility of product innovation. With the aim of increasing this possibility of innovation, post-doctoral research is being developed that aims to propose an inspiration tool through a simplified manual that moves between photography of natural elements and the search for concepts based on the perception of shapes of natural elements. And the first theoretical part of this research, which will be presented in this article, is the connection of bibliographic references between the research objects, which are Creativity, Innovation, Bioinspiration and Surface Design.

This research is justified primarily by the essence of design, which is creativity and innovation. And secondly by the constant search for new methods and combination of methods to achieve a product within the possibility of innovation. New methods and new creative situations are added daily to the creative process of new products. (KAYAT & MAGALHÃES, 2018 p2).

> "Developing creative capacity is important for designers, as it can influence the success of a new product, brand or service, differentiating them through novelty and quality, increasing their competitiveness and generating innovation" (KAYAT & MAGALHÃES, 2018 p.2).

Still in the text, the author refers to creativity - not as a gift, but as a capacity that must be stimulated and highlights the importance of techniques for practice and development. Understanding the mechanism of the mind in the creation process is important to seek creativity. Genter e Markman (1997) apud Kayat & Magalhães (2018) developed research to understand these mechanisms and discovered that creativity is the result of observation, association, comparison, correspondence, similarity, similarity, memory, mapping and combination of ideas that were not previously related, thus generating original solutions. Alex Osborn (1948 p.103) in his book Applied Imagination he states that the mind goes through the understanding of the problem, a moment of expansion of the mind which is where the creative being must search in memory and in everyday life – ideas in as many numbers as possible, without judgment and then a moment of connection that It's time to choose the best ideas, that is,

judge the best ones and then define them.

## 2. DEVELOPMENT

The state of the art defined in the research was drawn up sequentially in a structured way at the level of development of the intellectual and scientific repertoire with the purpose of bringing together the interdisciplinarities that design has the function of uniting. However, the broad discussion that takes place on the areas pointed out results in the objectivity of the terms and information raised, focusing the state of the art of this research more on the correlation and links directly or indirectly linked to the main purpose of the research, which is the creative and objective phase of the design of Bioinspired Surface. In this way, a bibliographic connection was created of information that will be relevant for understanding, not just simply the terms raised, but rather the empirical link between the approaches, methods, technique, area and technology. Thus, figure 1 presents the broad organic mental map of how the State of the Art presents the most relevant points. However, in this article, only the bibliographic connection on Creativity, Innovation, Bioinspiration and Surface Design will be presented.



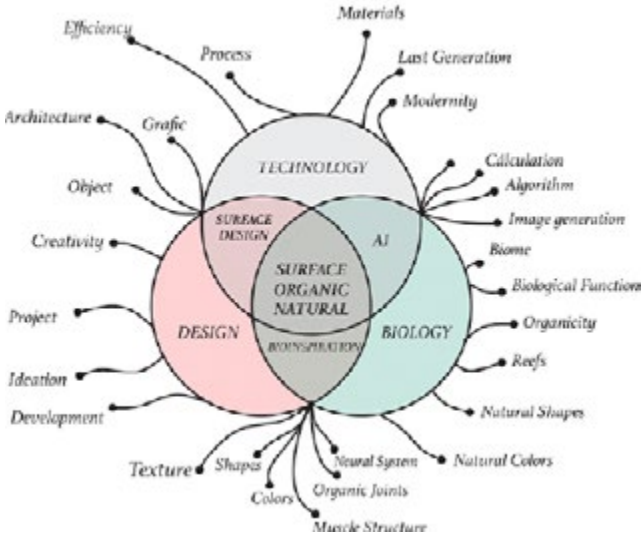


**Figure 1:** General Mind Map of the Literature Review.
**Source:** Author.

## 3. CREATIVITY AND INNOVATION [DESIGN]

In the absolute majority of references that discuss Creativity and Innovation, creativity always comes first and then talks about innovation. This sequence possibly follows the rite of Innovation. First you create and then you innovate, however, innovation must already be an objective at the moment of creativity. Therefore, knowing and truly mastering what innovation is is fundamental for a new look at creativity. Therefore, this topic was divided in this way, informing first about Innovation and then about creativity.

## 4. INNOVATION

It is important to emphasize that innovation is different from invention and this is often confusing. Not everything that is an invention is innovative, but everything that is innovative is invented. For something to be innovative, it must primarily be new and accepted by users. It is not enough to be creative, beautiful and attractive - the acceptance of the product, service (public or private) or graphic must be widely accepted by the target audience. There are a variety of methodological strategies for a product to seek innovation. The result is never certain, but the use of the innovation strategy must use tricks so that this search is more assertive, and that the loss gap gives way to a successful product (KOTLER, 2011 p.18).

An innovative product is the result of a series of initiatives implemented and developed by the corporation through the collaboration of various sectors. Every innovation starts from an individual, be it the boss, the leader, the owner of the company, an employee, or even a user. Innovation grows stronger as more individuals and processes take part in the development stages and the fulfillment of creative and development activities strategically forms the methodological stages and a series of questions are answered, developed and resolved. Hence the importance of intellectual training and the repertoire of each individual, whether through books, courses, lectures and conferences. Intellectual repertoire is the framework for creativity and innovation. The more contact individuals have with new artifacts and technology, the more chances the group will have of achieving a favorable result. Seeking innovation is currently a tool for maintaining the company in the market. Innovating is necessary and essential for the company to develop and maintain itself in the brutal competition of offering products and services that make a difference in people's lives. An innovative product is the result of the extensive efforts of people. We will not use the topic to classify innovation in detail, however it is worth highlighting that in most innovations we have open and closed innovation, where the company in Open

Innovation brings new processes, products, machines, methods and repertoire. These activities aim to innovate in the product, process, organization or marketing (KOTLER, 2011 p.253, p254).

And in the midst of this highly planned development work comes creativity, which must also be structured and planned. Creativity is one of the most important tools for achieving an innovative product. The next topic will address this concept, initially presenting the beginnings of the creative activity of human beings.

## 5. CREATIVITY

In the book "Where humanity went" Neves (2015, p.188, p.189; p.255, p256) concludes that humanity began creative thinking around 50,000 years BP (Before the Present) where hominids They began to realize that they could simply create. Scientists called this moment "**The Creative Explosion of the Upper Paleolithic**". At this time, Paleolithic man also begins spiritual questions and observes that creativity arises with the imaginative power of supernatural thinking. Therefore, man begins an unprecedented journey towards the creativity of environments, artifacts, agriculture, discoveries and new ways of living, relating, eating, imagining and obviously spiritual relationships emerge. After approximately one and a half million years of existence, man embarked on a life full of new perspectives, including the discovery of fire 10,000 years later (40,000 BP) which further opened the range of creative possibilities. Man observed that nature was a great source of inspiration and also of resources and gradually began to evolve both in the use of materials and in the evolution of processes and of seeing and also representing reality. The cave paintings appear in the boiling of this moment and are the greatest example of the yearning for creative representation. Natural materials such as blood and calcium oxylate were used for rock art painting, as stated by Gillespie (1997) in his research "On human blood, rock art and calcium oxalate: further studies on organic carbon content and radiocarbon age of materials relating to Australian rock art". Rock art is humanity's first form of expression. Creativity gave rise to new representations, the finding and treatment of new raw materials and material extraction processes. 10,000 BP saw the appearance of the first metals, such as copper, and a great leap in the acceleration of processes that in turn were exponential until the Industrial Revolution (WERTIME, 1964).

In short, the movements that precede design itself and that creativity was already being used in abundance, but without methods, only as an empirical idea, emerge in the midst of global movements initiated by artisans, architects, artists and even engineers. In the "Arts and Crafts" and "Art Nouveau" movements initiated by architects and craftsmen in the early nineteenth century, the main goal was mass production without losing the quality of the artifact, as a result of the high demand for the search for the form and function of the products (BAUER, 1955 p.51). In the midst of the ebullience of the need to produce in series, with the same creativity as the exclusive pieces of artisans, the Bauhaus appeared in Germany in 1919 and the emergence of design as a professional activity began. The methods for the creation and development of products emerge producing a great flow for new solutions and creating a multitude of products and even new needs. At this same time, there are a variety of continuous and intersecting flows to human and technological development such as the industrial revolution and the first and second world wars. The emergence of the aerospace industry and the massive development of automobiles run parallel to these flows (DAVIS, 2012. p.2 ). On the other hand, various methodologies from different areas are initiated and creative methods begin to be developed. One of the first models developed about the creative moment was developed by Grahan Wallas, a social psychologist in 1926 (GOMES, 2011, p.110). The researcher elaborates some steps for creative development. And so the stages of Identification (defining the Problem), Preparation, Incubation, Warm-up, Illumination, Elaboration and Verification were proposed emphasizing the rationality of creative human thought.

Later in his book Applied imagination Alex Osborn (1953) describes the creative moment as being basically the choice of the problem, displacement (expansion of ideas without judgment) and connection of ideas (choice of the best alternatives) and that later methods of creativity would follow this logic. Figure 2 shows the flowchart based on the author's assumptions. It should be noted that the Brainstorming and Brainwriting also proposed by Alex Osborn follows this conceptual basis. Design Thinking, although much more complex, follows the same sequence proposed by Alex Osborn.

Still about creativity – Bioinspiration is one of the most fantastic methods of creativity and development based on observation and strategies that nature uses to solve its problems.

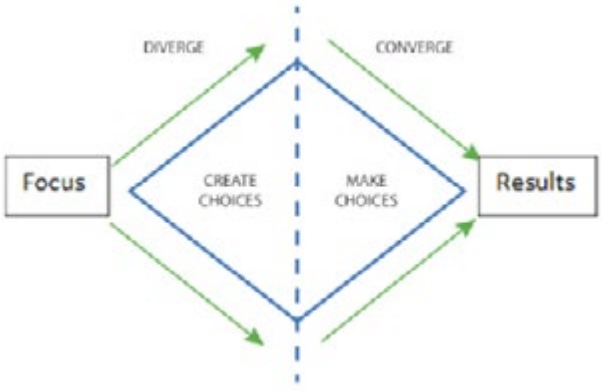


**Figure 2:** Flowchart based on the book Applied Imagination (OSBORN, 1953)
**Source:** Author.

## 6. BIOINSPIRATION

Goethe (2018) in his book "Doctrine of Colors" exposes that the use of colors with Bioinspiration promotes greater assertiveness in the harmony between flows and proposals of different color combinations. Based on the creative process and the use of techniques that facilitate this process, Biomimicry brings a framework of approach, observation, the need for training of the biological environment, technique, aggregated knowledge and the personal power that each individual has when joining the steps that the method proposes with the creative capacity and expansion of consciousness. The strategic observation of how nature solves its problems and the solutions proposed by existing bodies is what makes the Biomimicry method one of the most fantastic methods of development and research among other methods in the field of design, architecture, services and engineering. A current example is presented in the research "Biomimicry and artifacts for aquatic environments: strategies of lightness and resistance inspired by the cellular structure of agave" where Araújo (2015) concludes that the natural strategies of lightness used by agave constitute a series of organic forms distributed in tune with the cell walls with microscopic spaces distributed in a balanced way along the agave tassel. In an analysis of other works developed, it is observed that biomimicry is an important tool to contribute to the inspiration of creativity in Design. The author concludes that:

> "It is not about developing the lightest and most resistant material, but rather carrying out studies and seeking answers on how these materials and structures behave, an account of how they behave within this concept of lightness and resistance, with the behavior of the samples being studied, and how these can be applied to specific functions according to the potential of each material (Araújo, 2015). "

In a research with a greater relationship between Surface Design and Bioinspiration, Guerra (2018) in the article entitled: "Surface design and bionics: nature as inspiration in the creation of prints for clutches" states that the proposed combinations of harmonious and organic form by nature brings originality and exclusivity to the design project which results in the attractiveness of users' observation. Users' search for something that is exclusive and original can be a relevant factor for the innovation of the developed product. The author states that bioinspiration is clearly linked to the first art and design movements such as Art Nouveau. One of the great names of Art Nouveau is Lalique, who focused on natural elements of fauna and flora to perform his creativity at its highest level. Figure 3 clearly presents this characteristic that Lalique applied to his creations.

**Figure 3:** Cockerel Diadem, Vase Ceylan e Dragon Fly.
**Source:** https://www.du-grand-art.fr/arts-decoratifs/19eme-siecle/art-nouveau/artistes/rene-lalique/

It is observed that the aesthetics of objects brings a possible attraction that corresponds to the natural beauty of shapes, organic curves and textures, not created from absolute zero by Lalique, but rather inspired by copies and junctions of the natural elements most relevant to him at the moment. of creative eureka. Norman (2004) states in his book Emotional Design that in relation to product observation, design reaches three levels, the Viceral: this is when our brain identifies and judges a beautiful object and feels attraction regardless of its functionality; o Behavioral: which is the perception of the product about its usability and o Reflective: it is about the context of the product, cost, function, aesthetics, sustainable, etc. Reaching the three levels is the pinnacle of design and the method approach ends up seeking this level to the maximum. A product reference, surface design and the object of this research, Bioinpiration, is the Acaú Armchair

by designer Sérgio Mattos. Figure 4 shows the elkhorn coral (Acropora cervicornis) found on the south coast of Paraiba in the town of Acaú and on the north coast of Pernambuco in the town of Carne de Vaca. It served as the inspiration for one of the most iconic armchairs in modern Brazilian design. Initially, the morphology of the elements can be observed, where they have points that resemble moose antlers with their tortuous points, sometimes pointed and sometimes rounded, and often in the shape of plates. The organicity of the coral gives the perception a unique characteristic that may be difficult to reproduce functionally in a product. However, the activity of design seeks a solution through its projective methods.

**Figure 4:** Coral Chifre de Alce .
**Source:** https://www.mundoecologia.com.br/animais/coral-reino-filo-classe-ordem-familia--e-genero/

Designer Sergio Mattos' page describes Poltorna's project and states that;

> "Inspiration is lifted from the sea. A dive into the talent and keen eye of the Mato Grosso designer based in Paraíba, Sérgio Matos, who brings to light the products from the "Corais de Acaú" collection. The hallmark of its exotic design - imbued with the identity of the surroundings - appropriates the shapes of the Horn of Alce coral and brings together the artisanal and sustainable concept in collaboration with seafood restaurants and artisans from Acaú, a beach in the Paraíba municipality of Pitimbu. The armchair with a concave line and steel base evokes the poetry of a reef at the junction of the thousand pieces that support the structure. The perfect assembly simulates the limestone aesthetic reproduced in the wire that bends to the reference of nature and gains the coverage of cotton thread and the intensity of red varnish. The texture exudes fidelity to the inspiration that rests beneath the tides." (MATTOS, 2023)

Figure 5 demonstrates the full result of the creativity inspired by the acaú corals on the south coast of Paraíba. Addressing all the complexity proposed by the coral, Bioinspiration, resulting in a level of complexity and alternation of forms when applied to the final product and aiming for its replicability.

**Figure 5:** Acaú armchair.
**Source:** https://pt.sergiojmatos.com.br/product-page/aca%C3%BA-armchair

Therefore, it is concluded that natural forms have been addressed by developers for some time, where fauna and flora are quite common as creative inspiration and that nature exudes capacity as a mentor for the development of products, services and graphics. The organicity and variety of proposals presented by nature is infinite and carries with it the entire framework of billions of years, resulting through Bioinspiration new and exclusive products that offer greater access to innovation. Regarding Bioinspiration and the framework of creativity, the marine biome primarily holds in its complex diverse existence an infinity of creative possibilities. Therefore, the following topic provides this survey with important information to be observed and followed when searching for the Marine Biome as part of the creative development of research or products.

### 6.1 Marine Biome

Almost one hundred percent of the water on the planet is seawater, and for this reason planet Earth could be called a water planet. It is from the sea that a large amount of the oxygen that we breathe comes from. The Marine Biome needed to be characterized and there was already important research in this regard until the

World Congress of National Parks that took place in Bali, Indonesia. The Marine biome is named by the academic and research community as Marine-aquatic Biome or Aquatic Biome and is responsible for 71% of the planet's surface coverage. 97% of the water that covers the Planet is oceanic. The marine Biome is made up of a complex and diverse ecosystem chain that ranges from shallow coastal waters such as beaches, the margins of islands and continents to deep waters such as ocean trenches. Marine Biomes are a great climate regulator, temperature equalizer, production of oxygen and other important gases for the preservation of species and are therefore extremely important for the vitality of planet Earth. (Hayden, 1984).

Depending on the references, marine biomes may vary in their classifications, but are generally classified into 3 categories: Deep Marine, Coastal Marine and Pelagic. Hayden (1984) in his article Classification of coastal and marine environments classified the Marine Biome as Oceanic Kingdom, Coastal Kingdom, Seas and Archipelagos.

**Deep Marine Biome** – also known as the Abyssal zone, the depths of the oceans, the ocean floor and the marine trenches are included in this classification. The temperatures present here are very low and the pressure of the water volume is very high, resulting in an extreme living situation. However, there is a multitude of abyssal fish, worms and microorganisms highly adapted to this environment. (Hayden, 1984).

**Coastal Marine Biome** – Specifically, Coral reefs and Mangroves are part of this classification, along with Estuaries, Coastal Lagoons, Grasslands and Seagrasses and Rocky Coasts. It is one of the most diverse classifications and contains several types of ecosystems that differ in their biological characteristics and functions. This biome is characterized by its positioning close to the land areas of continents, islands and archipelagos..

- **Coral Reefs** – Coral reefs, which are one of the objects of research and inspiration for this work, are classified in the coastal Marine Biome and involve a series of variables for their existence and maintenance. One of the most important variables for the survival of corals in the sea is temperature. This variable includes sensitivity on the part of corals that survive in a narrow temperature range that, for the most part, thrives between 23 and 30 C. One of the largest coral communities in the world is present in the coral triangle that encompasses tropical countries: East Timor, Solomon Islands, Philippines, Papua New Guinea, Malaysia, Indonesia. This area contains 605 zooxanthellates, including 15 regional endemics. Thus resulting in 76% of the world's total complement of species, giving this province the highest conservation priority in the world (Veron, 2011).

As this topic is part of the research object, a specific topic about corals will be covered in this work in a broader and more specific way.

**Figure 6:** The upper coral line are photos of Corals on Koh tal in Thailand and the lower line are Corals present on Gili in Lombok in Indonesia.
**Source:** Author in photographic field research.

- **Mangroves** – The mangroves that are also part of the coastal marine biome and that, due to their important function for the biological system of the coastal ecosystem, were taken into account in the photographic research of this research so that, like corals, they serve as a tool for creative inspirations in bioinspired Surface Design. Mangroves are coastal ecosystems found between seas, hills, rivers and the mainland, islands, estuaries. The trees found in these areas are highly adapted to the salinity of sea waters and also serve as breeding grounds for various species of fish around the world. The longest continuous mangrove coastline is in the Amazon. Approximately 85% of Brazilian mangroves occur along 1,800 km of the northern coast of the states of Amapá, Pará and Maranhão, which together contains 10,713 km2 of these ecosystems (COHEN, 2012. p.50-58). Indonesia contains the largest mangrove cover in the world. To give you an idea, the total area of mangroves in the world is estimated at 137,760 km2 and is distributed in 118 countries. Indonesia, which has the largest mangrove cover in the world and has been losing about 52,000 hectares per year over the years. Indonesia contains one of the world's largest reserves of blue carbon, precisely because of its large cover of mangroves, grasses and corals. Mangroves are great

photosynthesizing carbon filters and with that the importance of their preservation for other species of fauna and flora are also preserved (ARIFANTI, 2020).

- **Estuaries** – Estuaries are transition areas between the Sea and the River. They are very rich in nutrients and are home to a diversity of marine life. The reproduction of many species occurs in these areas precisely because of the protection of marine currents (Arthurton Et al., 2005).

- **Coastal lagoons** - These are permanent or endless aquatic environments that are present near the seas and are separated by dunes or terrestrial arms and are home to fish, reptiles, birds and a flora adapted to salinity. (Arthurton Et al., 2005).

- **Rocky Coasts** – Rocky beaches are characterized by the presence of a variety of rocks and substrate. The size and types of rocks may vary depending on the location and region where they are located. These places also serve for the development of coral life and reproduction of marine species. (Arthurton Et al., 2005).

- **Seagrass Prairies** – These are large concentrations of algae and marine plants that serve as a food framework for fish, turtles, small and medium-sized marine animals (Arthurton Et al., 2005).

**Pelagic Marine Biome** - The pelagic marine biome is the open ocean waters and is considered the largest marine biome. This biome is classified according to the presence of sunlight. It is therefore divided into three: a) Euphotic - Where photosynthesis takes place, i.e. sunlight penetrates at a higher percentage. B) Dysphotic - Sunlight penetrates with less brightness and heat and c) aphotic - which are the depths of the oceans where sunlight does not reach due to the density of the marine waters. (Floeter, 2009).

We can conclude that the marine biome is highly diverse in classifications, subclassifications, and functionally important for marine and terrestrial life. In the object of the research, which are corals, a variety of shapes and colors can be observed that can easily be used as inspiration in products and especially in bioinspired surface design. The textures, shapes, organicity, elemental positions, creases, reliefs produced in a natural way by the corals are of an assertive aesthetic precision and of great relevance for inspirations in the field of design, whether in graphic and textile use with the purpose of sharing the importance of Bioinspiration, or in the field of product design. This variety of forms produced by corals opens up the field of creativity and, consequently, the sensitivity of innovation of bioinspired products. The natural surface design produced by corals is of great value for acquiring the creative framework in the development of bioinspired surfaces.

### 6.2 Surface design

Man's interest in graphic manifestations and the interest in making records coincide exactly with the aforementioned moment of the creative explosion of the Upper Paleolithic, whose drawings presented graphics referring to survival, hunting, moments of spirituality, explosions of creativity, thus establishing forms a connection to the events experienced (RÜTHSCHILLING, 2008 apud GUERRA et Al, 2018).

> "Given man's different artistic manifestations throughout his existence, he has had to keep up with the evolution of his surroundings. In this sense, the professional emerges who will design, as well as reflecting the communication that exists between man, nature and objects; a professional who will be able to stamp creativity on surfaces, combined with contemporary needs. Associated with the professional is also the fabric" (GUERRA et Al, 2018).

Therefore, the main objective of surface design is to develop reliefs, textures and prints that can be placed on floors, fabrics, household utensils, coverings and carpets. For Freitas (2009, p8) surface design develops active communication produced through sensory elements and codes. Surface design appeals more to the emotional than the functional, but surface design interacts with the various classifications of design, as well as at different levels of design, with regard to the function and aesthetics of the product. For this brief literature review, we will describe Surface Design in three main topics, Coatings, Carpets and Fabrics and Other Objects.

## 7. COATING

Surface Design is widely applied to the engineering, architecture and interior design sectors. As mentioned,

emotional appeal is directly linked to surface projects that indicate some identity with the place, with history, based on some natural element and that meet some of the design levels proposed by Emotional Design. Norman (2008) states that design contains three levels, the Viceral, Behavioral and Reflective Levels. Where the viceral level is the first impression we have of the product, it is basically linked to the emotional and disconnected from the functional, that is, it doesn't matter if the product works, what matters is the emotion I have when observing it. Works of art or architectural works in Dubai, for example, have this characteristic. Curves and aesthetics used have few elements applied to the functional and the proposals are more linked to the emotional impact they will cause on people. In figure 7 you can see the surface design applied to the coating of the Largest Frame in the World (Dubai Frame) located in Dubai in the United Arab Emirates, where it uses gold materials, a surface design developed specifically for this purpose and The fact that its dimensions result in the largest frame in the world makes people impressed by the architectural ensemble of the project and eliminates the real function of a work in this format, where empty spaces could be occupied in a functional way.



However, it is observed that the function of the building itself is simply to generate a frame that in the background can see the sky or, depending on its position, can see the city of Dubai with the Burj Khalifa in the background. The golden materials bring an aspect of grandeur, grandeur and power to the monument. And the surface design is inspired by the Expo Dubai 2020 Logo as shown in figure 8.


**Figure 8:** Expo 2020 dubai UAE logo
**Source:** https://news.sap.com/mena/2019/10/expo-2020-dubai-runs-sap-to-help-personalize--visitor-experiences/

The Dubai frame was designed by Mexican architect Fernando Donis in a competition offered by the Dubai government and whose theme was to present the "new face" of Dubai. The Competition had the participation of 926 participants (LYNCH, 2018).

At Ngurah Raide International Airport in Bali, Indonesia, one of the most diverse countries in terms of nature, surface design is present in a multitude of covering panels where nature, elements of culture and religious diversity are exposed. The exterior design projects combine modern and traditional Balinese architecture, characterized by wide domes interspersed with Stuka-type exterior roof designs, while the interior design develops a luxurious line with diversity in the use of colors and materials. (The private Word 2017) Figure 9 demonstrates the variety of colors, shapes and combinations proposed by the panels present at Bali airport.

**Figure 9:** Decorative covering panels at Bali airport/Indonesia.
**Source:** Author in field photographic research.

### 7.1 Carpets and Fabrics

One of the most important applications of surface design are carpets and fabrics and it was the proximity to these objects that Renata Rubin brought the term surface design to Brazil in the 80s. Renata Rubin is a surface designer and pioneer in Brazil and currently works developing projects for the most diverse areas of design with surface projects. In the presentation of her book drawing the surface there are a series of questions and statements about surface design, design and art. Where does one end and the other begin? There is a conservative line in design that resists the applications of Surface Design, more as art than design. However, the author incisively states that art is art and design is design and questions the clarity of this statement. *"A designer has to be able to understand the needs of other people and to use his imagination and creativity to format many of the objects and much of the environment that surrounds him..." (excerpt from a leaflet distributed by the Danish school Danmarks Designskole and replicated by Renata Rubin in her Book).* Perhaps it is in the development and production of the rug where there is a frank conversation between art, craftsmanship and design. In any case, the creative process, whether empirically (art) or development methods (design), must be stimulated so that the result is as attractive as possible and within harmonious patterns between colors, shapes, textures and, obviously, functionality. Creativity methods, as well as their stimulus tools, have in common the search for a repertoire with the aim of increasing the imaginative framework of solutions, shapes and color combinations. Table 1 weighs heavily in this search for repertoire proposed by RUBIN (2004). We chose to place an ipsis litteris print of the book precisely because of the importance that the search for new repertoires has in relation to the **creative process** and as Soares & Arruda (2018) state in their book about the importance of observing how nature operates in the creation of its species and through observation and translation of the execution of natural systems, it can be applied to some product, construction or artificial systems.

c) Dicas para formar um bom repertório de imagens/idéias:

1. olhar atentamente para tudo ao seu redor;
2. fotografar;
3. anotar idéias;
4. ir ao cinema, teatro, mostras de arte, shows e, se puder, viajar!

**Table 1:** The search for repertoire proposed by Renata Rubin in her book designing the surface (RUBIN, 2004)

Translating the original image we have:

C. Tips for creating a good repertoire of images/ideas

1. Look closely at everything around you
2. Photograph
3. Write down ideas
4. Go to the cinema, theater, art exhibitions, shows and if you can travel!

In the search for visual references for surface design, an on-site visit was carried out at the Great Mosque of Abudhabi / United Arab Emirates, where the Largest Carpet in the World is located, with exactly 5,400 square meters of fabric hand-embroidered by 1,200 weavers from the Province of Khorasan to carry out the design by Iranian artist Ali Khaliqi. The Persian rug was produced and weighs approximately 35 tons upon completion, where 30% is cotton and 70% wool. Regarding colors, it is predominantly green, however, it is made up of a total of 25 colors (AMBA, 2022). In figure 10, an organicity of shapes and colors is observed based on floral elements such as petals, flowers, leaves, thin stems, which provides the surface design with assertiveness within the scope of viceral design. In the place that is open for visitors, there is a collective emotional outcry where visitors, mostly non-Muslims, stay for minutes to observe the details and grandeur of the piece. Certainly the use of natural elements brings the viceral level to the extreme, precisely because of the requirement to reproduce these elements. The harmony of color combinations created by nature possibly provides such a result.

**Figure 10:** Largest Carpet in the World present in the Great Mosque of Abudhabi.
**Source:** Photograph produced by the author in photographic field research.

Still inside the mosque, surface design is present in other figurative elements. Thus demonstrating the importance that surface design has for the harmony, aesthetics and perception of the environment as a whole. For Rubin (2004) "surface design can be represented in the most diverse ways, as long as we accept that any surface can receive a project". Figure 11 shows other surface visual elements that make up the internal environment of the mosque.

**Figure 11:** Surface design in the composition of other elements of the Abudhabi mosque.



## 8. CONCLUSIONS

The theoretical review of a research is extremely important for the initial understanding of both readers and also important for rounding off concepts about the part and object of the research. This review is the result of the first part of post-doctoral research that has as its reference and connection creativity, innovation, Bioinspiration and surface design. It was observed in the theoretical field the absence of reference that connects Bioinspiration with surface design, although the photographic research that took place in the United Arab Emirates and at Bali airport in Indonesia as part of the topic of surface design, presents an excessive use of natural elements for composing environments through surfaces. Thus, the importance of expanding this connection with the aim of bio-inspiring the creativity of surface design and other fields of Design. Photographic research into the Marine biome, specifically corals, elucidates a multitude of compositions and color alternatives that, in the creative phase, can generate bio-inspired surface designs never before created. The formal compositions, the colors, the textures, the combinations, the organicity that corals play in their existence is an inexhaustible source of inspiration. Both the connections between theoretical concepts and the observation of natural and artificial elements (made by man) bring fuel to the creative framework and thus increase the possibility of innovation in a given project.

## REFERENCES

ARRUDA, A. A; FREITAS, T. L. NOVAS ESTRATÉGIAS DA BIOMIMÉTICA: AS ANALOGIAS NO BIODESIGN E NA BIOARQUITETURA NEW BIOMEDICAL STRATEGIES: ANALYSIS IN BIODESIGN AND BIO-ARCHITECTURE. **Mix Sustentável** | Florianópolis | v.4 | n.1 | p.73-82 | mar. | 2018.

ARIFANTI, V. B. Mangrove management and climate change: a review in Indonesia. **In**: IOP conference series: earth and environmental science. IOP Publishing, 2020. p. 012022.

ARTHURTON, Russell; KORATENG, Kwame. **Coastal and marine environments.** 2005.

ARAÚJO, Rodrigo Barbosa de. **Biomimética e artefatos para ambientes aquáticos:** estratégias de leveza e resistência inspiradas na estrutura celular do agave. 2015. Dissertação de Mestrado. Universidade Federal de Pernambuco.

ANBA, Agência de Notícias Brasil-Árabe. Acessado 18 de julho de 2023 - https://anba.com.br/mesquita-em--abu-dhabi-tem-maior-tapete-do-mundo/

BAUER, Carlton Edward. A STUDY OF THE ARTS AND CRAFTS MOVEMENT AND OF ART NOUVEAU IN RELATION TOINDUSTRIAL ARTS DESIGN. New York University, 1955.

Casa ABRIL. Acessado em: https://casa.abril.com.br/moveis-acessorios/

este-tapete-demorou-um-ano-e-meio-para-ficar-pronto.

COHEN, Marcelo Cancela Lisboa et al. Holocene palaeoenvironmental history of the Amazonian mangrove belt. **Quaternary Science Reviews**, v. 55, p. 50-58, 2012.

DAVIS, Ben. **The Bauhaus in History**. Artnet Magazine. Worldwide Corporation, 2010, p.2

FLOETER, Sergio R.; SOARES-GOMES, Abílio; HAJDU, Eduardo. Biogeografia marinha. Biologia Marinha. Rio de Janeiro: **Interciência**, p. 421-441, 2009.

FREITAS, Renata Oliveira Teixeira de et al. **As ações comunicacionais táteis no processo de criação do design de superfície.** 2009.

GOETHE, JW von. **Doutrina das cores.** Editora Nova Alexandria, 2018.

Gomes,L. V. **Criatividade e Design**: um livro de desenho industrial para projeto de produto.. Porto Alegre: sCHDs editora, 2011.

GUERRA, Amanda Marcon Ternes; NUNES, Me Alexandra Kloeckner Eckert. **O DESIGN DE SUPERFÍCIE E A BIÔNICA**: A NATUREZA COMO INSPIRAÇÃO NA CRIAÇÃO DE ESTAMPAS PARA CLUTCHES. Novo Hamburgo: Feevale, 2018.

GILLESPIE, Richard. On human blood, rock art and calcium oxalate: further studies on organic carbon content and radiocarbon age of materials relating to Australian rock art. **Antiquity**, v. 71, n. 272, p. 430-437, 1997.

HAYDEN, Bruce P.; RAY, G. Carleton; DOLAN, Robert. Classification of coastal and marine environments. **Environmental Conservation**, v. 11, n. 3, p. 199-207, 1984.

KAYAT, Claudia; MAGALHÃES, Claudio; **Design por analogoa impulsionado pela tecnologia:** Biomimética como exemplo. 13o Congresso Brasileiro de Pesquisa e Desenvolvimento em Design, Univille, Joinville (SC) 05 a 08 de novembro de 2018.

KOTLER, Philip. **A bíblia da inovação**. São Paulo: Leya, v. 33, p. 34-53, 2011.

LYNCH, Patrick. "Dubai Frame, a "maior moldura do mundo", é inaugurada em Dubai" ["World's Largest Picture Frame" Opens in Dubai] 20 Jan 2018. ArchDaily Brasil. (Trad. Baratto, Romullo) Acessado 14 Jul 2023. <https://www.archdaily.com.br/br/887028/dubai-frame-a-maior-moldura-do-mundo-e-inaugurada-em-dubai>

MATTOS, Sergio. Poltrona Acaú. Estúdio Sergio Mattos, 2023. Disponível em: https://pt.sergiojmatos.com.br/product-page/acaú-armchair. Acesso em: 18 de junho de 2023

MILLER, Michael J. et al. High biodiversity of leptocephali in Tomini Bay Indonesia in the center of the Coral Triangle. **Regional Studies in Marine Science**, v. 8, p. 99-113, 2016.

NEVES, Walter Alves; RANGEL JUNIOR, Miguel José; MURRIETA, Rui Sérgio S. **Assim caminhou a humanidade**. São Paulo: Palas Athena, 2015.

NORMAN, Donald A. **Design emocional:** por que adoramos (ou detestamos) os objetos do dia-a-dia. Rocco, 2008.

OSBORN, Alex Faickney. **Applied imagination; principles and procedures of creative problem-solving:** principles and procedures of creative problem-solving. Scribner, 1963.

PETROSKI, Henry. **Inovação: da ideia ao produto.** Editora Blucher, 2008.

RUBIM, Renata. **Desenhando a superfície.** São Paulo: Edições Rosari, 2004.

STEADMAN, P. **The evolution of designs – biological analogy in architeture and applied art**, 1a ed., Cambridge, Cambridge University Press. 1988

GORDON, W. J. J. Sinética: **El desarrollo de la capacidad creadora.** México: Herreros Hnos. S. A. 1963.

VERON, John EN et al. The coral triangle. **Coral reefs: an ecosystem in transition**, p. 47-55, 2011.

WERTIME, Theodore A. Man's First Encounters With Metallurgy: Man's discovery of ores and metals helped to shape his sense of science, technology, and history. **Science**, v. 146, n. 3649, p. 1257-1267, 1964.

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# URBAN GARDEN PROJECT: A PROJECT-BASED APPROACH APPLIED TO EXTENSIONEXPERIENCES AS A CURRICULAR COMPONENT

## *PROJETO HORTA URBANA: ABORDAGEM BASEADA EM PROJETO APLICADA EM VIVÊNCIAS DE EXTENSÃO COMO COMPONENTE CURRICULAR*

## *PROYECTO HUERTA URBANA: ENFOQUE BASADO EN PROYECTOS APLICADO EN EXPERIENCIAS DE EXTENSIÓN COMO COMPONENTE CURRICULAR*

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**ABSTRACT**

A resolution approved in 2018 by the Brazilian Ministry of Education defined in the curriculum matrices of undergraduate courses subjects that have an extension curricularization workload, allowing students to combine the content seen in the classroom with practical activities in external communities. In this context, this article presents the project report applied in the Extension Experiences curricular component, as well as the activities carried out, the procedures and the results of the application, with an expansion of the content displayed at the 2023 Sustainable Design Symposium. The proposal aimed to create a documentary and an awareness campaign for the implementation of urban gardens in neighborhoods in the city of Joinville (SC), Brazil. To execute the project, the double-diamond design method was chosen, considering the stages discover, define, develop, and validate, in addition to the adoption of an institutional platform for monitoring teachers and students and community participation. Here, we present the materials generated for the campaign and a discussion regarding the significant role played by extension experience activities in academic training.

**KEYWORDS**

Teaching in Design for Sustainability; Extension Curriculum; Extension Experiences.

***RESUMO***

*Uma resolução aprovada em 2018 pelo Ministério da Educação definiu nas matrizes curriculares dos cursos de graduação disciplinas que possuem carga horária de Curricularização da Extensão, propiciando que os estudantes além dos conteúdos vistos em sala de aula com atividades práticas em comunidades externas. Nesse contexto, este artigo apresenta o relato de projeto aplicado no componente curricular Vivências de Extensão, bem como as atividades realizadas, os procedimentos e resultados da aplicação, com ampliação do conteúdo exibido no Simpósio de Design Sustentável 2023. O objetivo da proposta visou à criação de documentário e campanha de sensibilização para a implementação de hortas urbanas nos bairros da cidade de Joinville (SC). Para a execução do projeto, optou-se pelo método design duplo diamante, considerando as etapas descobrir, definir, desenvolver e validar, além da adoção de uma plataforma institucional para acompanhamento de professores e estudantes e participação da comunidade. Como resultados, aqui se apresentam os materiais gerados para a campanha e uma discussão referente ao papel significativo desempenhado por atividades de vivência de extensão na formação acadêmica.*



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***PALAVRAS-CHAVE***
Ensino em Design para a Sustentabilidade; Curricularização da Extensão; Vivências de Extensão.

***RESUMEN***
*Una resolución aprobada en 2018 por el Ministerio de Educación definió en las matrices curriculares de los cursos de grado asignaturas que poseen carga horaria de Curricularización de la Extensión, propiciando que los estudiantes alíen los contenidos vistos en el aula con actividades prácticas en comunidades externas. En ese contexto, este artículo presenta el relato de un proyecto aplicado en el componente curricular Vivencias de Extensión, así como las actividades realizadas, los procedimientos y resultados de la aplicación, con ampliación del contenido exhibido en el Simposio de Diseño Sostenible 2023. El objetivo de la propuesta fue la creación de un documental y una campaña de sensibilización para la implementación de huertas urbanas en los barrios de la ciudad de Joinville (SC). Para la ejecución del proyecto, se optó por el método de diseño doble diamante, considerando las etapas descubrir, definir, desarrollar y validar, además de la adopción de una plataforma institucional para el acompañamiento de profesores y estudiantes y la participación de la comunidad. Como resultados, aquí se presentan los materiales generados para la campaña y una discusión referente al papel significativo desempeñado por las actividades de vivencia de extensión en la formación académica.*

***PALABRAS CLAVE***
*Enseñanza en Diseño para la Sostenibilidad; Curricularización de la Extensión; Vivencias de Extensión.*

## 1. INTRODUCTION

The Brazilian Ministry of Education approved a resolution in 2018 that establishes that at least 10% of the curricular workload of undergraduate courses must be dedicated to extension activities (BRASIL, 2018). Therefore, undergraduate courses needed to review their curricular structures to include extension actions. Therefore, subjects were defined with a workload focused on the curricularization of the extension, aiming to allow students to apply in practice the knowledge acquired in the classroom to solve specific demands.

This approach proposes to establish a transformative relationship between the university and society, encouraging the practical application of learning in real situations, contributing to strengthening and evaluating teaching and research, highlighting their relevance to society. Furthermore, it provides a critical assessment of the quality of the knowledge produced, consolidating the interaction between the university and the community (UNIVILLE, 2022).

Considering a classroom experience, this article presents a report on the application of an extension activity in the curricular component Creative Culture Actions for Extension Experimental Project. This component offers to students on the Advertising and Marketing and Cinema and Audiovisual courses at Universidade da Região de Joinville (Univille) an opportunity for curricular innovation by introducing them to university extension activities. Its purpose is to provide students with the experience of real situations, promoting the curricularization of extension through innovation and dissemination of ideas.

In this way, procedures and results of the implementation of an intercourse and interdisciplinary communication project are presented, promoting the students' protagonism, engaging them in a real activity and inserting them in practical contexts that demand the application of communication to disseminate their achievements.

The project demand presented to the students was the development of a publicity campaign for the implementation of urban gardens in the neighborhoods of the city of Joinville, in Santa Catarina, Brazil. Based on this demand, it was decided that the materials to be worked on would be a documentary and awareness-raising materials for distribution by the city hall.

It is understood that urban gardens play a significant role in communities, providing residents with the opportunity to grow fruits, vegetables, and greens for their own consumption and that of their families. Furthermore, surplus production can be sold, generating an additional income source to supplement the family budget. These gardens also have positive impacts on mental health, serving as a form of therapy for some people, while also encouraging the building of friendships between neighbors.

In addition to the personal and local benefits, the practice of urban horticulture contributes to the sustainability promotion, encouraging more conscious agricultural practices. It also plays a crucial role in environmental and food education, highlighting the importance of the connection between people, the local environment and food production.

Thus, the project consisted of creating a stimulus campaign to encourage other neighborhoods in the city to adopt the practice of urban gardening in their own communities. To achieve this, it was essential to visit the city's reference urban garden, understand its operation and benefits, conduct interviews, and interact with the community. The objective was to capture images and testimonies that revealed the community's relationship with the garden, to later synthesize this enthusiasm into graphic and audiovisual pieces.



## 2. DESIGN FOR SOCIAL INNOVATION

Social innovation can be understood as the phenomenon of proactive collective action to create solutions to community problems, generating new forms of social interaction. Communities are responsible for solving their own problems, sometimes creating alternative economic models of financial exchange (CIPOLLA & MOURA, 2011; BUSCH & PALMÅS, 2017). These new forms of organization are typical of social innovation. Often referred to as creative communities, which can be understood as communities of practice formed by groups of people, for various reasons (both private and public), they develop solutions independently and, ultimately, provide answers to the challenges that society faces in the transition to a more sustainable production and consumption model (MANZINI, 2007).

Creative communities are often organized from the bottom up, that is, by the people themselves affected by a particular problem or request. Thus, they have the potential to create radical innovations in the local system or even disrupt individual and/or system-wide habits regarding the context. In this sense, they question the

usual ways of producing, consuming, and relating to others (MANZINI, 2007). This disruptive and innovative potential of social innovations finds correspondence in the practice of design towards sustainability, giving the designer a viable participation role in the creative community.

Regarding the role of professional designers in this context, Lima and Martins (2011) state that the design practice itself cannot be separated from the social, environmental, and economic consequences of their activities caused by their action. Therefore, the designer's skill makes him/her one of the main professionals that can contribute to the success of social innovations. Hence the specification of social innovation design. According to Manzini (2017b, p. 76), "Design for Social Innovation" refers to "everything that Design can do to enable, support and guide social change in a sustainable way".

Thus, design for social innovation and the so-called social design have the coordination and interface inherent to their respective definitions. Manzini (2017b) states that social design often sets out to solve extremely problematic social situations–often addressed by philanthropic activities–that neither the official market nor the government can solve (or do not care about the policy to be addressed). Therefore, design for social innovation is not an isolated and independent field. On the contrary, it is linked to reality, reflecting the economic, political, and cultural situation of the given context (LIMA & MARTINS, 2011). In this sense, it is natural to realize that there is a great potential for social change through design projects and through these projects the concretization of the designer's social role.

Even if you do not always have the means or authority to impose your own worldview on others, the ability to influence the functional and aesthetic qualities of artifacts (products, services, systems) is still suitable for professional designers. Thus, the designer can operate purposefully based on the perception of new lifestyle and happiness scenarios in society (MANZINI, 2008). Therefore, it can be said that important questions about the social dimension of sustainability find in the design of social innovation a solid strategy to achieve and expand it. Among many action possibilities, urban agriculture presents itself as a type of social innovation in which the designer can act.



## 3. URBAN AGRICULTURE

For this study, the concept of urban agriculture is the practice of growing food (fruits, vegetables, herbs) and other plants in urban environments, whether for nutrition or for other purposes. Urban environments can be community gardens, rooftop gardens, public spaces, or even domestic ones. In this way, urban agriculture does not only provide healthy food, but also plays a crucial role in promoting social innovation, contributing to building more sustainable, inclusive, and resilient communities. Urban spaces are used to produce local food, promoting sustainability, food security, and the connection of communities with agricultural production.

Among the qualities that make it different from rural agriculture, urban agriculture is intensely integrated into the social, economic, and ecological ecosystems of cities. In urban agriculture, city residents can be hired as collaborators, have direct relationships with local consumers and can have some influence on policy and urban planning (MOUGEOT, 2000; VEENHUIZEN, 2006; RUAF, 2015). Urban agricultural activities range from purely commercial agriculture to collective initiatives and community gardens and also include domestic production for private consumption.

The benefits linked to urban agriculture practices are vast, including the creation of employment opportunities and additional income sources, food costs reduction, the stimulation of local market growth, the promotion of healthier eating, and the preservation of green spaces in urban areas. However, in several regions of the world, urban farmers have faced social, political, technical, environmental, and economic challenges, highlighting the urgency of increasing investments in public policies aimed at this sector (CUNHA & CARDOSO, 2022).

Being so diverse, urban agriculture creates forms of social interaction for those involved. This leads to a way of occupying and shaping urban space, motivating and promoting other demands, and reverberating political-ideological symbologies (TRACEY, 2007; REYNOLDS, 2009; NAGIB, 2016). According to Moraes (2005), the way cities present themselves helps shape people's social behavior. Thus, the tacit knowledge acquired by people involved in the practice of urban agriculture is both caused and influenced by the configuration of the city. The techniques, behaviors of those involved and the symbolic objectives of each initiative are all adapted, creating its own way of doing things (FENIMAN, 2014).

Urban gardens encompass several typologies, each of them characterized by its own specificities and the objectives they aim to achieve. Particularly, community gardens are predominantly established by families who cultivate them with the purpose of meeting their own food demands and/or to increase family income through the commercialization of cultivated products (SARAIVA, 2011 apud SOUZA, 2018).

By becoming green areas, community gardens become places of interaction, entertainment, and education, providing socio-cultural potential for coexistence, representing a new way of using public space. Furthermore, these spaces are managed and driven by civil society through associations or groups of individuals, standing out for the dynamism and dedication involved in urban agriculture practices (SOUZA, 2018).

The municipal practice of maintaining community gardens in Brazil dates to the 1970s. These gardens play a fundamental role in supplementing the income of families who are involved in urban agriculture, providing essential foods for those who do not have the resources to purchase them on the market. Thus, they contribute to food and nutritional security and enable the population to access fresh and healthy foods, while promoting dietary diversification, as highlighted by Pederson and Robertson (2006 apud SOUZA, 2018).

## 4. METHODOLOGICAL PROCEDURES

The project developed in this report took place in the second semester of 2022, in the 4th semester classes of the Advertising and Marketing and Cinema and Audiovisual courses, at Univille, in the curricular component Creative Culture Actions for Extension Experimental Project. The class was made up of 26 students, who were divided into free teams. The requested demand consisted of carrying out an awareness campaign to awaken the community's interest in creating urban gardens in the neighborhoods of Joinville.

To develop the proposal, the double-diamond design method (DESIGN COUNCIL, 2011) was used, which considered the procedural model through the steps: discover, define, develop, and validate.

It was necessary to use a digital tool that could record the entire process and monitor the project, as the subject has 50% of its workload of self-study, that is, there were asynchronous moments, in which the teacher was not in the classroom. In this way, an institutional platform was used, and, through the interaction on the platform, it was possible to clarify doubts, guide, and monitor the evolution of the project. The platform also served to maintain close students and the community.

The steps of the procedural model are detailed below:

a) Discover: at this stage, students needed to gather information about the project, searching for the necessary data to carry it out. To do this, they needed to: understand what an urban garden is, by desk research on reference websites, articles and books; identify user information, based on data collected in interviews and secondary information, leading to the creation of Persona tool, to identify the main characteristics of the public to whom the materials would be directed; and get to know the community that has the reference urban garden, through on-site research;

b) Define: based on the collected information, at this stage the important points of the project were defined, such as: the materials to be created to raise awareness and generate engagement in the respective community; the documentary script; ideas about the materials to be used to raise awareness and generate engagement and prepare the documentary script; initial proposals on the institutional platform; and contribution to the ideas of other teams on the platform;

c) Develop: this stage aimed at the development and production of the communication and documentary pieces defined in the previous stage. The details of the materials were defined, and the finalization was carried out;

d) Validate: the last step was applied to validate the proposal with the community. To this end, we sought to present and validate the materials developed, and make the materials available to the community, the city hall, and the municipal business association.

The activities planned to carry out the project were included both in the teaching-learning plan of the mentioned curricular component and in the annual activity report of the courses involved.

## 5. RESULTS AND DISCUSSION

The Extension Experiences I: Creative Culture Actions for Extension Experimental Project curricular component is applied both in the Cinema and Audiovisual and in the Advertising and Marketing courses at Univille, in the 4th semester classes. As a proposal for an extension experience activity, the demand "Awareness raising

campaign to awaken the community's interest in creating urban gardens in the neighborhoods of Joinville" was selected by the component's professor.

The partner community in this demand was the Adhemar Garcia neighborhood, which started an urban garden as an answer to the challenges of trash accumulation, vandalism, unpleasant odors, and pest infestation in an abandoned plot of land in the neighborhood. Community representatives made efforts, organizing meetings with residents to ensure everyone's cooperation. They carried out a survey to identify those interested in cultivating a plot in the garden, established a regulatory statute to formalize the participants' commitment, sought public resources for cleaning the land, preparing the soil, and fencing. These steps were essential to enable the effective start of the creation of the garden.

Thus, the objective of the project was to create an incentive campaign for other neighborhoods in the city to become aware of the action and adopt this practice of urban gardening in their respective communities, promoting social innovation in the localities. The results are descripted ahead, considering the defined design method.



### 5.1 Discover

To implement the demand in the classroom, the project teams needed to register on an institutional collaborative platform intended for exchanging ideas, in order to access materials related to the demand and participate in the subject's discussion group (extension). In this group, they were able to interact with other teammates, as well as members of the school community. Then, the teams conducted a research desk to understand the concepts of urban gardening, identifying construction methods and recognizing the actors involved in the process. The teams collected information about the planting and cultivation of fruits and vegetables, at the same time as they identified strategies to continue the proposal.

With the data collected, the students went to the field to recognize the information collected and identify new ones. They carried out an on-site visit to the community garden in the Adhemar Garcia neighborhood, to get to know the community and understand how their garden works. The garden is already established, well organized and has produced good results (Figure 1). The proposal was to have this garden as a reference and as an example of success in the implementation of other gardens, promoting adherence to the urban garden initiative in other neighborhoods of the city, in addition to using the material developed as a means of publicizing it.

**Figure 01:** Experience in urban garden in the Adhemar Garcia neighborhood, Joinville, SC, Brazil.
**Source:** institutional platform (2022).

At this stage, other visits to the community were carried out, depending on the teams' availability, in addition to interaction through the collaborative (institutional) platform.

The challenge was to gather students and the community due to differences in schedules, since classes are held at night and many students work during business hours (including Saturdays), making it an impediment for them to visit the garden and the community. Therefore, the use of the institutional platform was essential to guarantee interaction and collaboration between students, professors, and the community, facilitating communication and making the results obtained through discussion groups available.

Based on the analysis of the data collected, the teams created the persona maps considered in each proposal and the user's journey maps.

### 5.2 Define

In the second stage, based on the data collected, the important points of the project were defined, such as materials to be used to raise awareness and generate engagement in the respective community, and documentary script. In addition, there were generation of ideas about the materials to be used to raise awareness and generate engagement in the respective community and the documentary script, the presentation of initial proposals on the collaborative platform, and the contribution of ideas to other projects on the platform.

The Advertising and Marketing students were responsible for developing publicity and awareness-raising materials. Pieces were then defined for execution with the aim of propagating the campaign called 'Come plant'. The pieces defined were accessories with the brand's identity–cap and ecobag; Instagram profile and hashtag #vemplantar; digital book (Pdf) with tips and recipes; and definition of social actions for dissemination.

The documentary was created by the Cinema and Audiovisual course students, who defined the script to be worked on in this second stage.

### 5.3 Develop

This stage aimed at the development and production of communication pieces and the documentary. The teams developed some solutions, and the final proposals were presented on the collaborative platform, through which there were contributions from the professor, other colleagues and those responsible for the community garden involved. The proposals were also presented to members of the communication coordination of the city's Business Association (ACIJ) and Brazilian Support Service for Micro and Small Businesses (SEBRAE), for contributions and guidance in real time (Figure 2).

**Figure 02:** Presentation of the proposal.
**Source:** institutional platform (2022).

After the presentation and approval of the proposals, the materials were developed, so that other visits were made to the reference garden, mainly to record the documentary. Figure 3 shows some images of the development process of the documentary.

**Figure 03:** Development of the documentary.
**Source:** institutional platform (2022).

The documentary Cultivando Laços was developed, which can be seen in full via the link https://drive.google.com/file/d/1CypNHXhcpy4Fc2ruNSjhenD5e0tuf0tI/view. The documentary presents the social innovation process developed to generate the urban garden, as well as the benefits achieved by the community (Figure 4).


**Figure 04:** Excerpts from the documentary *Cultivando Laços*.
**Source:** our own.

Regarding the graphic pieces, the following were created, as illustrated in Figure 5: development of the campaign name and logo, "Come plant"; creation of accessories aligned with the brand's identity, such as caps and ecobags, intended for daily use by horticulturists in the garden or other environments, in addition to serving as publicity tools for the community; establishing an Instagram profile and adopting the hashtag *#vemplantar*; elaboration of a digital book in PDF format with guidance on growing and caring for urban gardens, along with recipes to optimize the use of cultivated food; and definition of social initiatives to be communicated through posters and informative folders.




**Figure 05:** Material developed for the campaign.
**Source:** institutional platform (2022).

### 5.4 Validate

The last step was applied to validate the proposal. For this, the materials developed were presented in a seminar, in the classroom. The contextualization of the proposal, the ideas generated, the development of the chosen solution, and the finalized proposal were presented. The seminar was attended by students, other course professors, members of the ACIJ Communication Coordination and SEBRAE and subsequently validated by the community, through its representative, who could not be present on the day of the seminar, but validated the material on the platform and attended the presentation of the documentary at the *Amostra Univille Ação Festival* (Figure 6).

**Figure 06:** Urban garden representative at the festival.
**Source:** institutional platform (2022).

The proposal for this approach demand of urban gardens aimed to encourage other communities in Joinville to adopt community gardens in their neighborhoods, contributing to the environmental, food and social dimensions. The main objective was to transform vacant lands, which impact the community safety and health, into productive spaces. To achieve this purpose, a detailed analysis of a well-structured reference garden in the city was carried out, in order to understand the specific needs and replicate it in different neighborhoods of the city.

The students organized themselves into teams to explore the reference garden and interact with producers/residents of the respective community. These moments provided a significant exchange of information between the garden participants, highlighting the students' protagonism. The activity required research, since many students had no prior experience with cultivation or knowledge about organizing a "cooperative". In terms of teaching, it was necessary to relate the knowledge acquired in specific courses (Advertising and Marketing; Cinema and Audiovisual) to contribute to solving the identified demands. Regarding extension, the initiative brought the university closer to the external community, generating concrete proposals and solutions for local needs.

It is important to highlight that one of the concerns was the possible incompatibility of schedules, since understanding the demand required active participation in the garden and the subsequent execution of the project. Classes took place at night, while activities in the garden occurred in the morning and afternoon, coinciding with many students' work schedules. However, the community mobilized to welcome students on Saturday mornings,

thus making the desired integration possible. This effort demonstrated readiness and commitment not only on the part of the garden representatives, but also the students involved.

Throughout the process of creating the proposal, the project was monitored by the ACIJ Communication team and SEBRAE, which gave students confidence about what they were developing. These institutions gave very satisfactory feedback, praising the quality of the material. They intend to apply the campaign throughout the city. The identification of possible lands in the neighborhoods for negotiations with the city hall has been done, to then run the campaign.

"Come plant" campaign, designed by students, encourages the implementation of new urban gardens in the city, and envisions visibility actions for neighborhoods and communities in the city and on social networks, through the creation of a profile account of Instagram and the availability of recipe books in PDF format. There was also concern in creating the visual identity of the campaign, as well as accessories convergent to the proposal and social actions that involve the distribution of folders using seed paper, which has the function of clarifying the importance and benefits of an urban garden. At the same time, it contributes to environmental issues and effectively encourages planting, as the paper contains seeds incorporated into its composition, allowing it to be planted.

The documentary, on the other hand, gives visibility and voice to the community, shows real stories and experiences, bringing the proposal closer to the reality of families. The documentary produced in the subject was shown at the *Mostra Univille Ação Festival* and is available on the student collaboration and feedback platform for the external community, as well as on YouTube.

The evaluation of the curricular component was carried out by the subject professor, considering: the presented references; the coherence of the results with the project proposal; the technical quality of the results; class attendance; the team's contributions to other proposals on the collaborative platform; and compliance with deadlines.

## 6. FINAL CONSIDERATIONS

Community members, together with their representatives, warmly welcomed the students and played a fundamental role in clarifying the functioning of the garden in its broadest areas. Furthermore, they shared their experiences about the difficulties faced and the achievements since implementing the garden. In their reports, a feeling of pride was evident due to the recognition of the work in the garden, the opportunity to participate in the project, the visibility obtained, and the respect shown by the students when presenting the proposals prepared. In many situations of projects carried out in communities, there is the lack of this feedback for the community itself, which can generate frustration, a feeling of neglect and even distrust on the part of the community in future projects.

The students' reports largely reflect positive aspects, expressing gratitude for the theme chosen for the project. They expressed satisfaction with the results achieved in the proposal, noticing a significant connection between the knowledge acquired during their studies and the practical application in the campaign project. The material produced does not only have genuinely real value, but also carries intrinsic social relevance, contributing to significantly enriching their respective academic portfolios.

The students and community's protagonism in the urban garden in the Adhemar Garcia neighborhood was surprising, but the creation of gardens in the city does not depend only on the campaign or the documentary. These materials help, clarify, contribute, inform, and raise awareness, but the fact is that the emergence of an urban garden is only possible if there are determination, representation, and engagement from the community itself. This is how social innovation takes place.

Thus, for the occurrence of social innovation based on the construction of a community garden, it is necessary the collaboration of the active community members, local organizations, and authorities, to create and maintain cultivation spaces, promote education, and ensure that benefits are shared equitably. It is important to create an environment that encourages participation, collective learning, and the creation of innovative solutions to local challenges.

Activities developed in the extension experiences component are of great relevance for the students' civic education, as the knowledge acquired goes beyond purely theoretical learning, as it provides practical experiences that enrich students' education, developing technical and social skills, values, and a deeper understanding of the society in which they live. Furthermore, it contributes to the formation of engaged citizens who are aware of their social responsibility.

## REFERENCES

BRASIL. Ministério da Educação. **Resolução No 7 de 18 de dezembro de 2018.** Estabelece as Diretrizes para a Extensão na Educação Superior Brasileira e regimenta o disposto na Meta 12.7 da Lei no 13.005/2014, que aprova o Plano Nacional de Educação – PNE 2014 – 2024 e dá outras providências. Available at: https://normativasconselhos.mec.gov.br/normativa/pdf/CNE_RES_CNECESN72018.pdf. Accessed on: Aug. 10, 2023.

BUSCH, O. V.; PALMÅS, K. **Social Means Do Not Justify Corruptible Ends**: A Realist Perspective of Social Innovation and Design. She Ji: The Journal of Design, Economics and Innovation, v. 2, n. 4, p. 275-287, 2017. Available at: https://www.sciencedirect.com/science/article/pii/S2405872617300631. Accessed on: Aug. 10, 2023.

CIPOLLA, C.; MOURA, H. **Social innovation in Brazil through design strategy**. Design Management Journal, v. 6, n. 1, p. 40-51, 2011. Available at: https://www.researchgate.net/publication/216832446_Social_Innovation_in_Brazil_Through_Design_Strategy. Accessed on: Aug. 10, 2023.

CUNHA, M. A.; CARDOSO, R. C. V. **Hortas urbanas na promoção da Segurança Alimentar e Nutricional e desenvolvimento sustentável em Salvador, Brasil.** Ambiente & Sociedade. São Paulo. Vol. 25, 2022. Available at: https://www.scielo.br/j/asoc/a/JnfmVX3jJYxjYFN53ZngbpM/?format=pdf&lang=pt. Accessed on: Aug. 8, 2023.

DESIGN COUNCIL. **The Double Diamond design process - still fit for purpose?** Medium. 2011. Available at: https://medium.com/design-council/the-double-diamond-design-process-still-fit-for-purpose-fc619bbd2ad3. Accessed on: Aug. 2, 2023.

**DOCUMENTÁRIO CULTIVANDO LAÇOS.** Available at: https://drive.google.com/file/d/1CypNHXhcpy4Fc2ruNSjhenD5e0tuf0tl/view. Accessed on: May 25, 2023.

FENIMAN, E. H. **Hortas curitibanas**: as representações simbólicas do cultivo de alimentos na cidade. 2014. Masters dissertation. Universidade Federal do Paraná.

Food and Agriculture Organization of the United Nations (FAO). **Urban Agriculture**. Available at: http://www.fao.org/urban-agriculture/en/. Accessed on: June 25, 2023.

LIMA, E. C.; MARTINS, B. **Design social, o herói de mil faces, como condição para a atuação contemporânea** in: BRAGA, Marcos da Costa. O papel social do design gráfico: história, conceitos & atuação profissional. São Paulo: Editora SENAC São Paulo, 2011.

MANZINI, E. **A laboratory of ideas:** Diffuse creativity and new ways of doing. in: MERONI, Anna. Creative Communities. Milão: PoliDesign, 2007.

MANZINI, E. **Design para a inovação social e sustentabilidade:** Comunidades criativas, organizações colaborativas e novas redes projetuais Rio de Janeiro: E-papers, 2008.

MANZINI, E. **Design: quando todos fazem design** - uma introdução ao design para inovação social. Tradução Luzia Araujo. São Leopoldo, RS: Ed. Unisinos, 2017 (b).

MORAES, A. C. R. **Ideologias geográficas.** São Paulo: Annablume, 2005.

MOUGEOT, L. J.A. **Agricultura Urbana – conceito e definição.** Revista Agricultura Urbana n01. Julho de 2000. Available at: https://ruaf.org/assets/2000/10/rau01_total.pdf. Accessed in: Apr. 2023.

NAGIB, G. **Agricultura urbana como ativismo na cidade de São Paulo:** o caso da Horta das Corujas. 2016. Doctorate Thesis. Universidade de São Paulo.

REYNOLDS, R. **On guerrilla gardening: a handbook for gardening without boundaries.** United Kingdom: Bloomsbury, 2009.

RUAF. Resource Centres on Urban Agriculture & Food Security Foundation. **Urban Agriculture and City Region Food Systems:** What and Why. 2015. Available at: https://ruaf.org/document/city-region-food-systems-what-and-why/. Accessed on: May 4, 2023.

SOUZA, J. S. **Hortas urbanas comunitárias em Salvador-BA:** organização, trabalho e alimentos.

2018. Masters Dissertation. Universidade Federal da Bahia. Available at: https://repositorio.ufba.br/bitstream/ri/32847/1/Disserta%C3%A7%C3%A3o%20Hortas%20Urbanas%20Comunit%C3%A1rias%20%20VERS%C3%83O%20FINAL.pdf. Accessed on: Dec. 20, 2023.

TRACEY, D. **Guerrilla gardening:** a manualfesto. Canadá: New Society, 2007.

VEENHUIZEN, R. VAN (Ed.). **Cities farming for the future:** urban agriculture for green and productive cities. Netherlands: RUAF & IDRC, 2006.

UNIVILLE. Universidade da Região de Joinville. **Plano de Desenvolvimento Institucional 2022-2026** - Joinville, SC: Editora Univille, 2022.

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# POPULAR HOUSING: A HUMANIZED ANALYSIS THROUGH THE 14 BIOPHILIC PATTERNS

## *HABITAÇÃO POPULAR: UMA ANÁLISE HUMANIZADA ATRAVÉS DOS 14 PADRÕES BIOFÍLICOS*

## *VIVIENDA POPULAR: UN ANÁLISIS HUMANIZADO A TRAVÉS DE LOS 14 PATRONES BIOFÍLICOS*

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**ABSTRACT**
Social housing has been discussed as an object of academic study since the 80s. Few academic proposals were approved by governments and transformed into effective actions. In this context, the objective of this article is to analyze in a humanized way the applicability of Biophilic standards, in social housing in the Imburi complex, located in the city of Pilar -AL. The study is part of an ongoing master's thesis research, with a behavioral, qualitative and analytical approach, with the main tool being semi-structured interviews. The research would initially be with (n)100 participants, but due to limitations the final sample was with (n)30 participants, which generated data tabulated in graphs showing the percentage of satisfaction in the different housing complexes Imburi I, II and III The study brings the careful and unconscious inclusion of the standards applied by residents in the homes, promoting a sense of belonging in the spaces and improving the quality of life.

**KEYWORDS**
Biophilic Design Patterns; Biophilic Design; Housing.

***RESUMO***
*A habitação de interesse social vem sendo discutida como objeto de estudo acadêmico desde a década de 1980. Poucas propostas acadêmicas foram aprovadas pelos governos e transformadas em ações efetivas. Nesse contexto, o objetivo deste artigo é analisar de forma humanizada a aplicabilidade das normas biofílicas, em moradias populares no complexo Imburi, localizado no município de Pilar-AL. O estudo é parte de uma pesquisa de dissertação de mestrado em andamento, com abordagem comportamental, qualitativa e analítica, tendo como principal ferramenta a entrevista semiestruturada. A pesquisa seria inicialmente com (n)100 participantes, mas devido a limitações a amostra final foi com (n)30 participantes, o que gerou dados tabulados em gráficos mostrando o percentual de satisfação nos diferentes conjuntos habitacionais Imburi I, II e III. O estudo traz inclusão cuidadosa e inconsciente dos padrões aplicados pelos moradores nos domicílios, promovendo o sentimento de pertencimento nos espaços e melhorando a qualidade de vida.*

***PALAVRAS-CHAVE***
*Padrões de Design Biofílico; Design Biofílico; Habitação.*



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## *RESUMEN*

*La vivienda de interés social ha sido discutida como objeto de estudio académico desde la década de 1980. Pocas propuestas académicas fueron aprobadas por los gobiernos y transformadas en acciones efectivas. En este contexto, el objetivo de este artículo es analizar de manera humanizada la aplicabilidad de las normas biofílicas en viviendas populares del complejo Imburi, ubicado en el municipio de Pilar-AL. El estudio es parte de una investigación de tesis de maestría en curso, con un enfoque conductual, cualitativo y analítico, teniendo como principal herramienta la entrevista semiestructurada. La investigación inicialmente contemplaba (n)100 participantes, pero debido a limitaciones, la muestra final fue de (n)30 participantes, lo que generó datos tabulados en gráficos que muestran el porcentaje de satisfacción en los diferentes conjuntos habitacionales Imburi I, II y III. El estudio destaca la inclusión cuidadosa e inconsciente de los patrones aplicados por los residentes en los hogares, promoviendo el sentimiento de pertenencia en los espacios y mejorando la calidad de vida.*

## *PALABRAS CLAVE*

*Patrones de Diseño Biofílico; Diseño Biofílico; Vivienda.*

## 1. INTRODUCTION

A long time ago, the approach to social housing stopped being just a political discourse and became an object of study in academic institutions. Since the 1980s, several teaching and research institutions have debated this issue. It is surprising to note that over almost three decades, few proposals originating in academia managed to obtain approval from governments at all levels and be transformed into effective actions (Palarme, 2007).

As pointed out by Caselli (2007), the concept of minimum housing originated around the 20th century, emerging after the First World War with the purpose of addressing the economic and social difficulties that emerged as a consequence of this conflict in Europe. However, from the 1990s onwards and, especially, at the beginning of the 21st century, academic institutions emerged as a possible ally of the government in the search for solutions to what has become the country's most significant social challenge: the problem of the housing deficit. Bauer, (2010).

Considering the role of the State in building housing for low-income people, there is no doubt. However, the complexity of this endeavor in keeping up with the increase in demand is also undeniable, especially in metropolises and medium-sized cities in Brazil, which continue to receive a constant influx of individuals in search of better living conditions. This persistent demand is, to a large extent, an outcome of the phenomenon of migration from rural to urban areas, a trend that has persisted in the country since the first half of the 20th century (Santos 2009).

According to Palermo (2007), within the scope of public housing policies in Brazil, the State's main objective is to reduce the housing deficit, often adopting a purely quantitative approach, where the housing issue is treated primarily as a statistical challenge. This results in the neglect of crucial social aspects, such as the sense of ownership of the home, the resident's sense of belonging in relation to their home and the community in which they live, as well as other factors of fundamental importance.

In 1929, a discussion began during the International Architecture Congress (CIAM), about a new housing paradigm aimed at collective use. This debate was influenced by several factors, such as overpopulation, housing deficit, precarious construction and unsanitary conditions, taking into account both economic and constructive aspects. This context motivated the search for the rationalization of buildings, which began to be planned according to the concept of the existential minimum. This involved not only the size of the buildings, but also the consideration of the psychological and biological needs of users in housing projects (Kapitzky, Muniz and Cunha 2019).

Boueri (1989), states that social and psychological factors influence the "organic actions of the body" and people's well-being. Therefore, there are certain "psychosomatic" demands that must also be incorporated and considered as criteria in defining minimum housing standards, seeking to progress towards the perspective that the minimum housing standard should not depend exclusively on dimensional and physical assessments related to space and domestic activities (Mendonça and Villa, 2018).

Considering housing as a cultural element, it must be capable of appropriation by its resident. This involves the user's ability to be an "agent of the space", as defined by Szücs (2005, apud Palermo, 2007), allowing them to make modifications according to their needs and wishes. This interaction expresses not only their culture, but also their future aspirations, creating a meaningful symbolic connection between the resident and the physical environment of the home, resulting in a deep sense of belonging. Assuming that experiences in space can trigger both positive and negative responses in individuals, affecting their well-being in cognitive, behavioral and physiological aspects, it is important to highlight the challenges faced by families in new public housing. In this context, the objective of this work is to analyze in a humanized way the applications of Biophilic standards, in Popular housing in the Imburi complex, located in the city of Pilar-AL.

Biophilic, standards are increasingly being used as an important tool to make the environment a source of innovation, restoration, change, resilience, and adaptability user in the space that filters and processes information and their assessment of the environment built (Wilson, 1986, Kellert 2012 and Nehme 2008). Furthermore, the research addresses Popular housing, highlighting its importance in the social, cultural and economic context. And with this, the State plays a fundamental role in providing housing as a means of social inclusion. These dwellings not only provide shelter, but also influence residents' identity and participation in society, allowing the expression of their culture and values.

## 2. THEORETICAL FOUNDATION

Based on the understanding of the relevance of knowledge not only in the cultural, social and economic context, but also in the expressive interaction between housing and the resident's future appreciations, a symbolic and meaningful connection emerges between the user and the physical environment. According to Malard (2002), housing, when considered as a human habitat, encompasses concepts that largely transcend the idea of simple shelter. Reducing housing to mere protection against climatic conditions is limiting humanity to its biological dimension, thus neglecting its social dimension. Housing represents for human beings an anchor point in the world, where they build their dreams for the future and to which they always return. Being at home is more than being protected; It's being in your own environment and, at the same time, at the center of the universe.

Faced with disorganized migration from rural to urban areas, Brazil's housing policy emerged, the purpose of which is to mitigate the shortage of housing. This approach often prioritized the quantity of housing units over quality, adopting a cost reduction strategy that manifested itself in a reduction in the size of housing. Furthermore, this policy has often neglected the social and cultural aspects that contribute to residents' sense of belonging in relation to the space of their homes and communities (Bonduki, 1998).



Considering the challenges associated with public housing, one of which refers to the limited internal space that prevents a positive experience on the part of residents, Pereira (2007) highlights the importance of empowering residents to meet their natural needs and to take ownership of the environment in which they live. This would provide security and the ability to become active agents of the space they inhabit.

Thus, through research on biophilia, biophilic design was identified that focuses on the integration of biophilic patterns, with the connection between natural elements and nature in the built environment. Which present a variety of applications for interior design professionals who design built spaces, both indoors and outdoors. These standards must be versatile and adjustable, allowing for adequate integration into projects. Therefore, biophilic design can be seen as a crucial tool in creating restorative environments (Kellert, Calabresa, 2015).

Contributing to solving the challenge in the family context in the built environment, which is finding the balance between an environment that offers a wealth of interesting and restorative information, and an environment that contains an excess of information, leading to feelings of overload and stress (Browning, 2014).

Reeve (2012 ), states that with the positive effects extremely useful caused by biophilia in the field of medicine, the construction industry has agreed to promote the use of it in the built environment, considering the quality in life as fundamental experience, because when it's applied, it promotes feelings of positive emotions, such as connection to the place, the environmental identity, perception from the restoration, sustainable behavior, or taking it as a hypothesis, it works as a trigger for a direct or indirect positive effect, whether on an emotional, cognitive, aesthetic or spiritual level.

However, the emotional bond (bond or affinity) established between an individual and an environment, considering their environmental care and history Kalvaitis, Monhardt and Nisbet (2015), compared to any other place, whether natural or urban, when it is positive, encourages commitment to adopting pro-environmental behaviors. This benefits both the environment and the person, as the person is able to recognize the restorative qualities that result in greater psychological restoration. Appreciation or connection with the local environment can be seen as a manifestation of biophilia, and this positive relationship has a beneficial effect on psychological restoration (Berto 2018 and Hartig, 2001).

Therefore, to understand biophilic design, it is important to recognize that the standards are grouped into three distinct categories, represented below in figure 1 (Biophilic Patterns), each with its fundamental concepts that play a crucial role in application in environments, internal or external:

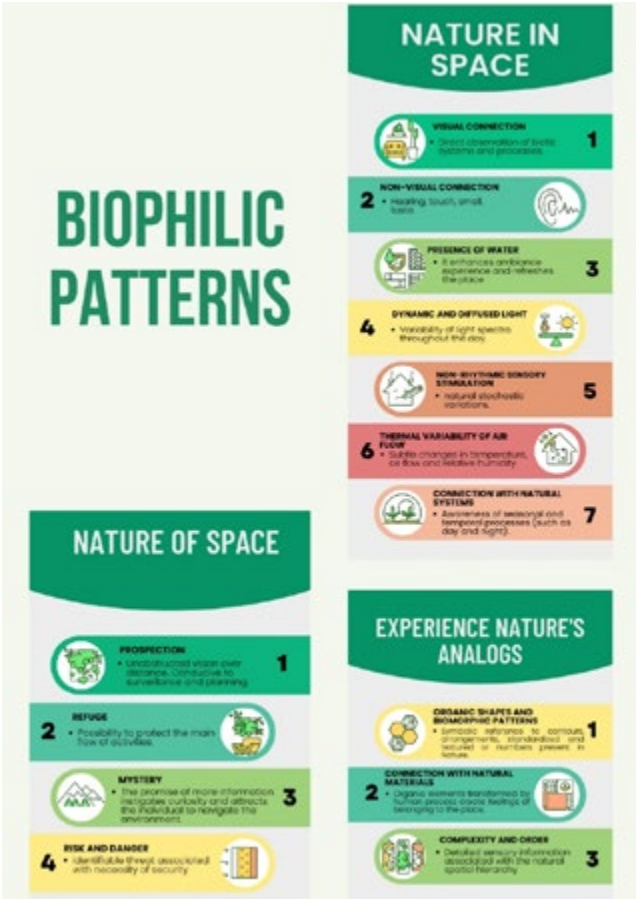



**Figure 1:** Infographic Table.
**Source:** prepared by the Authors (2023)

According to Browning (2014), patterns in nature are supported by developed empirical interdisciplinary research which highlight works from Christopher Alexander, Judith Heerwagen, Rachel and Stephen Kaplan, Stephen Kellert, Roger Ulrich and many others. From these studies on biophilia, 14 biophilic patterns were extracted that have a variety of applications in the built environment, internal or external, enabling the implementation making flexible and adaptable at the space focused on psychological, physiological and cognitive benefits.

To create a restorative environment, it is important to consider the principles of biophilic design, as described by Edward Wilson (1984). When examined in isolation, these principles reveal emotional, psychophysiological, and cognitive connections to the built environment. It is essential to take care of how these principles can be applied and used for deeper understanding. Table 1 follows to assist figure 1 above.

| Biophilic Patterns | |
|---|---|
| **Description** | |
| Natural in Space | - Addresses the direct, physical and ephemeral presence of nature in a space or place. This includes plant life, water, and animals, as well as breezes, sounds, scents, and other natural elements. |
| Natural Analogs | - The edge is the direct, indirect presence of nature. such as colors, shapes, sequences and patterns found in nature, manifest as works of art, ornamentation, furniture, decoration and textiles in the built environment. |
| Nature of Space | - Addresses spatial configurations in nature. This includes our innate desire and learning to be able to see beyond our immediate surroundings, our fascination with the slightly dangerous or unknown; obscured visions and revealing moments; and sometimes even phobia-inducing properties when they include a reliable element of security. |

**Table 1:** Category Classification.
**Source:** prepared by the Authors (2023)

As highlighted by Browning (2014), the principles of nature are supported by extensive interdisciplinary empirical research, which includes work by renowned scholars such as Christopher Alexander, Judith Heerwagen, Rachel and Stephen Kaplan, Stephen Kellert, Roger Ulrich, among others. From these investigations into biophilia, 14 biophilic patterns were identified, with diverse applications in the built environment, both indoors and outdoors. These standards allow for a versatile, adaptable implementation focused on psychological, physiological and cognitive benefits, thus contributing to the improvement of the built environment.

This article represents ongoing master's research that seeks to revisit the concepts within the scope of biophilia and identify biophilic patterns that can be applied in the built environment, specifically in popular housing. Its objective is to provide a relevant contribution to the field of Interior Design, through substantial reflections related to improve the resident's experience with their homes.

The focus of the research is to analyze living spaces that are safe from both physical and emotional point of view, allowing the performance of various activities. The goal is for these spaces to provide positive responses based on the user's experiences in the environment.

## 3. METHODOLOGICAL PROCEDURES

This article is part of ongoing master's thesis research, which adopts a behavioral, qualitative and analytical approach, with its main focus being semi-structured interviews, using the questionnaire developed by Henry Sanoff (1995), Wish Poem (wish poem), starting from the sentence to be completed, "I would like my environment...", with a sample of participants of (n) 100 participants, (n) 20 per family, considering 5 Individuals per residence , with the inclusion and exclusion criteria, residents aged 18 years or over (inclusion) "participants", residents aged under 18 years. (exclusion) "non-participants".

To make the results regarding the applicability of biophilic standards to the object of study, social habitation in the Imburi housing complex in Pilar-AL, it was necessary to guarantee the reliability and safety of the participants, since one of the stages of the research involves interviewing human beings. It was necessary to submit the research project to the CEP-Ethics and Research Committee, Involving Human Beings at the Federal University of Pernambuco.

Thus, after positive evaluation and approval by the CEP, it was possible the beginning of the research, enabling the interview and the physical survey of the environment, located in the Imburi housing complex in Pilar, Alagoas. These housing complexes, which have an area of 211,800 $m^2$, shelter popular housing for low-income families.

The research was supported by the guidance of Professor Ph.D. Amilton José de Vieira Arruda (Advisor) and Prof. Dr. Antônio Roberto Miranda de Oliveira (Co-advisor).

For the recruitment of participants, the first approach was the presentation of the researcher, who introduced himself as a student of (PPGD), Postgraduate Program in Design at UFPE, Federal University of Pernambuco and shortly afterwards presented the research in a summarized and informal way, so that they were comfortable participating voluntarily. After the presentation, they were asked if he/she or they could voluntarily answer a questionnaire, making it clear that the research would not take more than 10 to 15 minutes.

To collect the data, a semi-structured interview was used with the application of the questionnaire, taking photographs of the physical environment and measurements of the physical space, audio recording and filming.

We also take the risks and benefits of the research for the participants as possible embarrassment in the face of some questions about the quality of housing, satisfaction and understanding of daily dynamics. However, as absolute confidentiality and preservation of the interviewees' personal information will be maintained, this risk is minimized, without losses for the interviewees. It is up to the researcher to have the sensibility to understand and the delicacy to talk around the situation leaving the participant free to make their contribution to the studies.

Regarding the participant's exposure to the pandemic caused by Covid-19 and possible fatigue from a daily routine, the tool applied was only ask beforehand if there would be availability to be interviewed. The use of mask and gloves was also taken into account, both for the participant and for the interviewer/researcher if they felt safer and more comfortable using it.

As for the benefits of this research, these were indirect. The study sought to encourage the interviewee to talk about their home, aiming to materialize a project that matches their wants, desires and needs in the space in which they live. Mainly, because the housing complexes are developed in a specific "mold", therefore, made in accordance with the requirements of the state government program.

These families are not assisted or heard, according to their needs, according to regional specificities, cultural and family peculiarities and the user's subjectivity are not respected, as there is no interaction with the process of construction of the physical space capable of establishing order and rules, so that you must have knowledge of the actions and usability, providing the user with appropriation based on a look at the use. Therefore, listening to and watching them generates positive emotions and feelings that are important for their well-being.

However, the participants' responses were analyzed and interpreted, based on interviews, physical and photographic surveys, video and audio recordings and observation exercises, using graphs and tables.

## 4. LIMITATION OF THE SEARCH

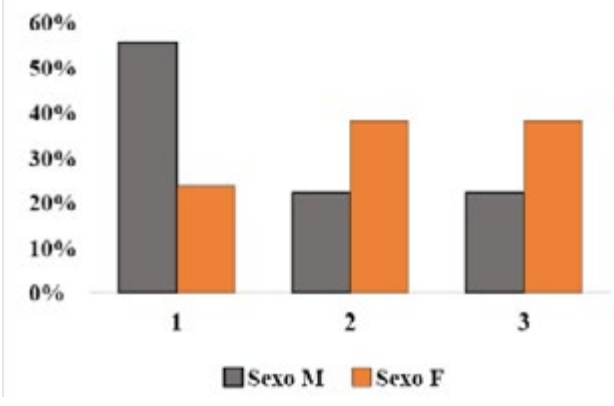
It is necessary to comment on the limitations of the research, the first concerns the number of participants that would have as a sample (n) 100 participants, considering (n) 20 families, (n) 5 Individuals per house. But due to unavailability and the freedom to choose whether or not to voluntarily participate in the research, we had as a sample (n) 30 participants, (n) 1 per family, considering (n) 5 Individuals per household.

Another limitation of this study was the division of the Imburi housing complex in Pilar-AL appointed by Imburi I, Imburi II and Imburi III, this division was chosen (n) 30 residences, with (n) 10 for each Imburi considering that each housing complex has around (n) 600 houses.

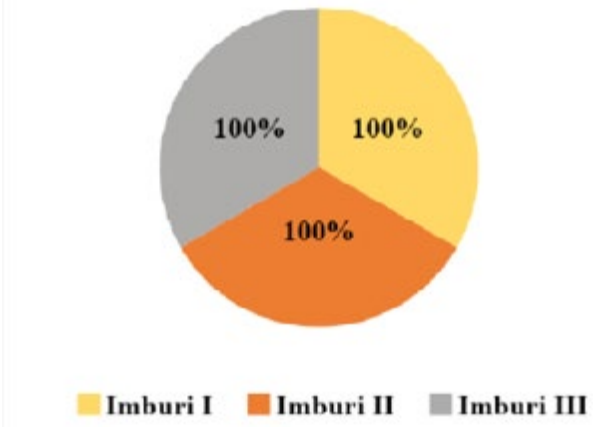
## 5. RESULTS ANALYSIS

The first analysis was interviews which the percentage number of male and female participants presented in graph 1 was tabulated. It had a significant percentage for the answers given during the interview, with 56% of male participants in Imburi I, 22% of participants of the Imburi II and III. On the other hand, 24% of participants were female in Imburi I and 38% of participants were female in Imburi II and III.

In graph 2, the percentage of user satisfaction in Imburi I, II and III for the residences was 100%, based on the question "do you like the house you live in?" Yes or no"… everyone answered ( yes ).

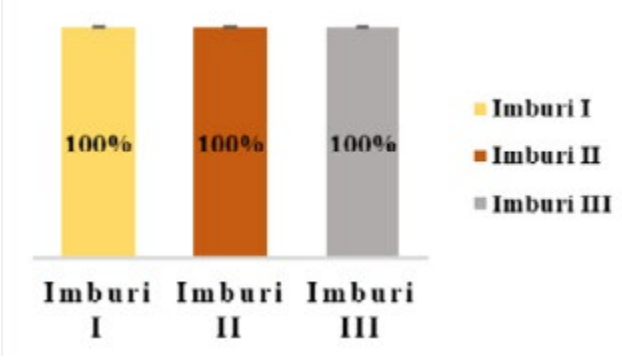



**Graph 1:** Percentage of participants by gender.
**Source:** prepared by the Authors.

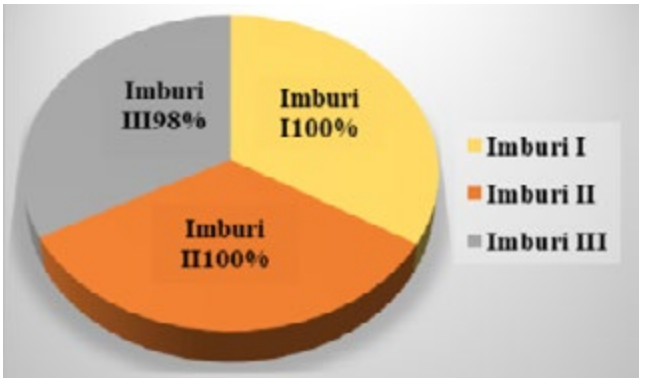



**Graph 2:** Percentage of user satisfaction nwith homes.
**Source:** prepared by the Authors.

In graph 3, the percentage of user satisfaction in relation to the living room, kitchen and bathroom in Imburi I, II and III were 100% with observations, given the location of the room and the physical size. In graph 4, percentage of user satisfaction in relation to the rooms was 100% in Imburi I and II, in Imburi III it was 98%.




**Graph 3:** Percentage of user satisfaction in relation to the living room, kitchen and bathroom.
**Source:** prepared by the Authors.




**Graph 4:**
**Source:** prepared by the Authors.

Table 2. Below presents relevant information about the changes made to the houses, offering a comprehensive and organized view of the data related to this topic. This table was created with the aim of simplifying the understanding of residents' needs for social housing, allowing a clearer and faster coverage of the elements involved. Based on the information provided about the changes made to the houses of Imburi I, Imburi II and Imburi III, a series of modifications that occur in each of them can be observed. These changes cover different areas and purposes, making each house unique in terms of adaptations and use of space. Below, we highlight the main changes made to each of the houses:

| Changes that were made to the houses | |
|---|---|
| **Description** | |
| Imburi I | - Expansion of the kitchen;<br>- Use of the front space to open shops: workshop and grocery store<br>- Expansion of the backyard – service area. |
| Imburi II | - Expansion of the kitchen,<br>- Use of the front space for a garage and opening of shops: sale of construction materials.<br>- Use of the (alley) next to the house as a pantry for workers' meals. |
| Imburi III | - Expansion of the kitchen and opening of its window.<br>- Use of the yard for animal production,<br>- Use of the living room wall to install an aquarium;<br>- Added a wall throughout the house. |

**Table 2:** Participant changes.
**Source:** prepared by the Authors (2023).

Table 3. Presents a compilation of suggestions from participants for the development of popular housing in the possible Imburi IV project. Offering a comprehensive and well-equipped view of data related to possible desires regarding a home consulted and designed for families that accommodate an average of (n) 5 individuals per residence.

These proposals aim to create more accessible, functional and attractive spaces for future residents of an imaginable Imburi IV, taking into account different needs and preferences. Below is an overview of the opnions for each housing category: Imburi I, Imburi II and Imburi III.

| Possible future popular housing - Imburi IV | |
|---|---|
| **Description** | |
| Imburi I | - Accessible space for disabled users;<br>- Larger kitchen and bedrooms plus another bedroom;<br>- Bathroom close to the bedrooms, but far from the living room;<br>- Smaller wooden windows |
| Imburi II | - Larger kitchen;<br>- American kitchen;<br>- Bathroom close to the bedrooms, but far from the living room;<br>- Front with wall space for garage;<br>- Colors in the house;<br>- Smaller glass windows; |
| Imburi III | - Larger kitchen and bedrooms plus another bedroom;<br>- Bathroom close to the bedrooms, but far from the living room;<br>- Front and backyard with wall;<br>- Colors in the house. |

**Table 2:** Suggestions from Participants.
**Source:** prepared by the Authors (2023).

The house is much more than just a physical place to live, it is the stage of our lives, the refuge where we share moments of joy, love, and even reflection on the influence it has on us Dietz (2021). Each house has its own story, its own charm and personality. It is a space where the individual finds his identity and intimacy; where the decoration reflects the tastes and values of its inhabitants. The images, figure 2, 3 and 4, captured are a diverse universe, a variety of desires and stories these houses can tell and the reality of the inhabitants' needs, it is important to highlight that 15 images were chosen to represent the three Imburi housing complexes.

**Figure 2:** Imburi I housing.
**Source:** prepared by the Authors (2023).

**Figure 3:** Imburi II housing.
**Source:** prepared by the Authors (2023).

**Figure 4:** Imburi III housing.
**Source:** prepared by the Authors (2023).

It is possible to find biophilic design standards applied even if unconsciously due to the user's need and the relationships the resident has with home. For this reason, the observation, capturing images and the interviews was necessary to understand how the applicability of biophilic design standards were carried out. Based on the categories of biophilic patterns: nature of Space, Nature in Space and Nature Analogs, they will be represented by the letter **(P)** of pattern in table 4 below.

| Application of biophilic design standards in housing I, II, III | | | |
|---|---|---|---|
| **Description** | **Nature in Space** | **Nature Analogs** | **Nature of Space** |
| Imburi I Housing | P1, P2, P4, P6 | P2, P3 | P1, P2, P4 |
| Imburi II Housing | P1, P2, P4, P6 | P2, P3 | P1, P2, P4 |
| Imburi III Housing | P1, P2, P4, P5, P6, P7 | P2, P3 | P1, P2, P4 |

**Table 4:** Participant applications.
**Source:** prepared by the Authors (2023).

The data above confirms men's need for nature and the benefits it can bring to users in the built environment, social housing. It is understood that even without understanding and professional knowledge in the field, in this case interior design, it is clear that men in their essence need the relationship with nature in his habitat. Therefore, the Biophilic Design encourages an emotional connection to settings and particular places, promoting positive interactions between people and nature.

## 6. FINAL CONSIDERATIONS

In conclusion, the incorporation of biophilic design standards in residences, social housing, generates a significant impact on the user's needs such as well-being and quality of life. Salingaros (2019), Kellet and Calabrese (2015) and Browing, et al. (2014) state that it is essential to incorporate natural elements and nature connections in the design of living spaces.

Therefore, it was observed that even without the residential project and without the guidelines of biophilic design standards, there was applicability of these patterns in the residence, due to the need of men, as their essence seeks this relationship with nature through its natural

elements, the research brings as an example in homes: natural light by window openings, which provide natural ventilation; contact with water and animals through a simple aquarium in the living room; the plants that make up a garden in the flower bed by the door , the colors green and blue printed on the walls of the living room, kitchen and balcony, providing a feeling of tranquility and connection with the natural world; the use of gates and walls around the house brings a feeling of privacy and security.

Importantly, biophilic standards not only improve the aesthetics of homes, but also promote emotional and physical balance of inhabitants, making them a fundamental approach to the interior design and architecture of residential environments.

Furthermore, the examples presented in the research demonstrated that the careful and unconscious integration of biophilic design patterns made by residents promotes a sense of belonging and calm; it contributes to well- being and improved quality of life, strengthening interpersonal relationships, helping to reduce stress and increase concentration, covering physical, emotional, cognitive and social aspects. Therefore, as we move forward in the search for more sustainable and healthy ambiance, the conscious application of these standards is a priority in interior design and home construction, bringing more balanced and harmonious environments.



## REFERENCES

BAUER, Rosa. Sustainability and Social Housing: The Challenge of Sustainable Intervention in the Favela Discussed at the Academy In: SYMPOSIUM NATIONAL MEETING OF THE NATIONAL ASSOCIATION FOR RESEARCH AND POST-GRADUATION IN ARCHITECTURE AND URBANISM 1., 2010, Rio de Janeiro. **Annals** [...]. Rio de Janeiro: ANPARQ, 2010. p. 199-206.

BERTO, Rita et al. An individual's connection to nature can affect the perception of restoration of natural environments. A few observations on biophilia. Behavioural Sciences, **MDPI**, Basel, Switzerland, 2018, v. 8, n. 34, p. 1-18, mar. 2018.

BONDUKI, Nabil. **Origins of social housing in Brazil** - Modern architecture, Tenancy Law and diffusion of the Proletarian House. São Paulo: Estação Liberdade, 1998.

BROWNING, W; RYAN, C; CLANCY, J. **14 Biophilic Design Patterns**. New York: Terrapin, 2014.

CASELLI, Cristina Kanya. **100 Years of Minimum Housing:** Emphasis on Europe and Japan. Advisor: Dr. Gilda Collete Bruan. 2007. 273 f. Dissertation (Master's Degree in Architecture and Urbanism) – Post-Graduation from the Mackenzie Presbyterian University of São Paulo, São Paulo. 2007.

DIETZ, Karine Maria. The home as **an instrument for the user's well-being. Multidisciplinary Scientific Journals**, São Paulo, V. 01, n. 6, p. 66-80. June 2021.

KALVAITIS, D: MONHARDT, R. Biophilia of the infant voice: the phenomenology of being in love with nature. **Journal of Education for Sustainability**. United States.v. 9, p. 1-15, Mar. 2015.

KAPITZKY, S. H. A; MUNIZ, A. F.; CUNHA, C. A. F. Contemporary Minimum Housing: Analysis of Ergonomic Parameters. In: BRAZILIAN SYMPOSIUM ON PROJECT QUALITY IN THE BUILT ENVIRONMENT, 6., 2019, Uberlândia. **Annals** [...] Uberlândia: UFU, 2019. p. 320-332.

KELLERT, E. R. **Birthright: People and Nature in the Modern World.** New Haven: Yale University, 2012.

KELLERT, S. CALABRESE, E. The practice of biophilic design. **Terrapin Bright**. London. 2015, v. 3, p. 1-26, May. 2015.

FEDERAL UNIVERSITY OF MINAS GERAIS. **Research report:** post-occupancy evaluation, user participation and quality improvement of housing developments: a phenomenological approach. [Minas Gerais: UFMG], 2002. Available at: <https://www.caixa.gov.br/Downloads/desenvolvimento-urbano-habitacao/Coletanea_Habitare_Volume_1.pdf>. Accessed on 16 Feb. 2023

MENDONÇA, R. N. VILLA, S. B. Ways of living: the concept of appropriation as a qualifier of housing in contemporary design. **Graphic Education.** São Paulo. v. 22 n. 1, p. 242 – 258. Apr. 2018.

NEHME, Valéria Guimarães de Freitas. The topo-biophilical ties that transform spaces into places for workers and students of the Federal Agrotechnical

School of Uberlândia (MG): a perceptive approach in geography. 2008. 236 f. Thesis (Doctorate in Human Sciences)-Post-graduation in Geography at the Federal University of Uberlândia, Uberlândia. 2008.

PALERMO, Carolina et al. Social Housing: a projectual view In COLLOQUIUM ON RESEARCH IN HOUSING MODULAR COORDINATION AND MUTABILITY. 4., 2007, Belo Horizonte, MG. **Annals** [...] Minas Gerais, UFMG, 2007. p. 1-11.

PEREIRA, Gabriela Morais. **Spatial Accessibility in Popular Housing:** a Project Evaluation Instrument. Advisor: Dr. Carolina Palermo. 2007. 165 f. Dissertation (Master's Degree in Architecture and Urbanism) - Post-Graduation from the Federal University of Santa Catarina. Florianópolis, 2007.

BRISBANE INTERNATIONAL CONFERENCE, 10., 2012, Australia. **Informing healthy building design with biophilic urbanism design principles: a review and synthesis of current knowledge and research.** Perth: Curtin University/QUT, [2012].

SALINGAROS, Nikos Angelo. The biophilic cure index predicts the effects of the built environment on our well-being. **Journal of Biourbanism**. Rome Italy. v. 8, p. 13-34, Jan. 2019.

SANOFF, Henry. **Creating Environments for Young Children.** North Carolina State University: CreateSpace Independent Publishing Platform, 1995.

SANTOS, Janio. Urbanization and production of cities in Bahia: reflections on the processes of urban structuring and restructuring. **Bahia Análise e Dados**, Salvador, Bahia, 2009, v. 19, n. 2, p. 499-509, Sept. 2009.

SZÜCS, Carolina Palermo. Social Interest Housing. In: SZÜCS, C.P. P**roduction, design and technology (Discipline).** Post-graduation in Architecture and Urbanism. UFSC, Florianópolis-SC, June 2 to Aug. 18. 2005. Lecture Notes. In: PALERMO, Carolina et al. Social Housing: a design view In COLLOQUIUM ON RESEARCH IN HOUSING MODULAR COORDINATION AND MUTABILITY. 4., 2007, Belo Horizonte, MG. **Annals** [...] Minas Gerais, UFMG, 2007. p. 1-11.

WILSON, E.O. **Biophilia**: The human bond with other species. Cambridge, Massachusetts: Harvard University Press, 1986.

_____. **Biophilia:** The human bond with other species. Cambridge, Massachusetts: Harvard University Press, 1984.

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# CERAMIC DESIGN WORKSHOP: A CREATIVE EXPERIENCE THROUGH TERRITORIAL JEWELRY WITH THE FLOR DO BARRO GROUP, ALTO DO MOURA, CARUARU –PERNAMBUCO/BRAZIL

## *WORKSHOP DE DESIGN CERÂMICO: UMA EXPERIÊNCIA CRIATIVA ATRAVÉS DE JOIAS DE TERRITÓRIO COM O GRUPO FLOR DO BARRO, ALTO DO MOURA - PERNAMBUCO*

## *TALLER DE DISEÑO CERÁMICO: UNA EXPERIENCIA CREATIVA A TRAVÉS DE LA JOYERÍA TERRITORIAL CON EL GRUPO FLOR DO CLAY, ALTO DO MOURA - PERNAMBUCO*

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**ABSTRACT**
This article presents the results of the Ceramic Design workshop around the theme of territorial jewelry to promote creativity and strengthen the feeling of belonging to a collective of women from the Flor do Barro group in Alto do Moura, a suburb of the city of Caruaru, in the state of Pernambuco-Brazil. The main objective of the workshop was to challenge them to explore other possibilities of forms with clay during the execution of the academic extension project "Clay Flowers: mapping and ideation of the craft production chain". The workshop was planned and carried out through workshops based on design tools to stimulate the creative and productive capacity of artisans. The processes of Ideation, Generation and Selection of alternatives; Planning, Execution and Detailing of ten products; Prototyping and Testing were used. Experimenting with the Flor do Barro group territory jewelry is a strategy for valuing ceramic knowledge, through design and its dialogic character for the group's sustainability.

**KEYWORDS**
Ceramic Design; Territory Jewels; Craftsmanship.

***RESUMO***
*Este artigo apresenta os resultados do workshop de Design Cerâmico em torno do tema da joalheria territorial para promover a criatividade e fortalecer o sentimento de pertencimento a um coletivo de mulheres do grupo Flor do Barro em Alto do Moura, um subúrbio da cidade de Caruaru, no estado de Pernambuco-Brasil. O principal objetivo do workshop foi desafiá-las a explorar outras possibilidades de formas com argila durante a execução do projeto de extensão acadêmica "Flores de Barro: mapeamento e ideação da cadeia produtiva artesanal". O workshop foi planejado e realizado por meio de oficinas baseadas em ferramentas de design para estimular a capacidade criativa e produtiva das artesãs. Foram utilizados os processos de Ideação, Geração e Seleção de alternativas; Planejamento, Execução e Detalhamento de dez produtos; Prototipagem e Testes. Experimentar a joalheria territorial com o grupo*

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*Flor do Barro é uma estratégia de valorização do conhecimento cerâmico, através do design e seu caráter dialógico para a sustentabilidade do grupo.*

***PALAVRAS-CHAVE***
*Design Cerâmico; Joias Territoriais; Artesanato.*

***RESUMEN***
*Este artículo presenta los resultados del taller de Diseño Cerámico en torno al tema de la joyería territorial para promover la creatividad y fortalecer el sentimiento de pertenencia a un colectivo de mujeres del grupo Flor do Barro en Alto do Moura, un suburbio de la ciudad de Caruaru, en el estado de Pernambuco-Brasil. El principal objetivo del taller fue desafiarlas a explorar otras posibilidades de formas con arcilla durante la ejecución del proyecto de extensión académica "Flores de Barro: mapeo e ideación de la cadena productiva artesanal". El taller fue planeado y realizado a través de talleres basados en herramientas de diseño para estimular la capacidad creativa y productiva de las artesanas. Se utilizaron los procesos de Ideación, Generación y Selección de alternativas; Planificación, Ejecución y Detallado de diez productos; Prototipado y Pruebas. Experimentar la joyería territorial con el grupo Flor do Barro es una estrategia de valorización del conocimiento cerámico, a través del diseño y su carácter dialógico para la sostenibilidad del grupo.*

***PALABRAS CLAVE***
*Diseño Cerámico; Joyas Territoriales; Artesanía.*

## 1. INTRODUCTION

Flor do Barro group, formed in 2014 by twenty women artisans, arose with the intention of greater recognition of local female crafts. The women who make up the group are, for the most part, daughters, sisters and granddaughters descended from the famous families of Mestre Vitalino and his disciples. The women who make up the group are, for the most part, daughters, sisters and granddaughters descended from the famous families of Mestre Vitalino and his disciples. The formation of the group began through the first meetings that took place in the home of one of the members. Since 2023, the group has had its headquarters at Casa da Mulher Artesã do Agreste, in Alto do Moura neighborhood in Caruaru-PE.

Alto do Moura is a neighborhood in the city of Caruaru, in Pernambuco - Brazil, located approximately 7 km from the city center. It houses one of the most important craft centers in the country, and gained national notoriety thanks to the projection of one of its most illustrious artists, Mestre Vitalino. Still alive, Vitalino Pereira dos Santos - Mestre Vitalino - had what the locals call disciples, artisans dedicated to the continuation of his art. Inspired by the works created by Mestre Vitalino, the themes reproduced by the artisans, who follow his tradition, are folkloric motifs and which portray the daily life of country people, such as: the bumba-meu-boi; the maracatu, the fife bands, the refugees from the drought, the cangaço and the cangaceiros (mainly the famous Lampião and Maria Bonita), the cowboy, the rodeo; the wedding; burial in rural areas, etc.

Since the first half of the 20th century, the production of artistic ceramics has become the largest source of income for families in the neighborhood. Currently, at ABMAM - Association of Clay Artisans and Residents of Alto do Moura, more than 700 artisans are registered. However, the representation of women artisans is still small in the community and local crafts no longer represent the tradition inherited by Mestre Vitalino. The majority of artisans also work producing utilitarian pieces, dolls, and surrealist works that follow Mestre Galdino's aesthetics. And to this day, handicrafts are sold in the artisans' own homes and studios, which provides the neighborhood with a tourist route.

In an attempt to bring design and local crafts closer together, in 2021, through immersion in the reality of the Flor do Barro group, the project was carried out: "Flores do Barro: mapping and ideation of the craft production chain". The project was registered as an Extensionist Action for the Design Course at the Federal University of Pernambuco. The general aim of the project was to propose, through design and its dialogical character, strategies for valuing resources for the production and commercialization of handicrafts from the Flor do Barro group do Alto do Moura-Caruaru.

One of the results obtained from this project was the analysis of the Flor do Barro group Production Chain, which investigated the functioning of the artisanal environment, by tracking the techniques, routes and agents involved from obtaining the clay to the commercialization of the pieces. From the analyzes it was possible to notice that women artisans have a collective performance format and group speech, however, each of the participants produces, burns and finishes their pieces individually, in their homes or studios (SANTOS et al, 2023).

This result corroborates the doctoral studies carried out by Barbosa (2019), when she observes that the practice of artisanal activity in the Alto do Moura neighborhood occurs individually, despite family groups sharing creation and commercialization spaces. All artisans in the neighborhood follow the technique of manual plastic clay modeling and fire their ceramic pieces in low heat capacity kilns (< 800 oC) fueled by wood and finish the pieces with cold, polymer-based paint (SANTOS et al, 2022).

The artifact and the artisanal environment manifest a series of meanings, traditions and practices rooted in a place. Among the composition that surrounds this construction is design, which cannot be reduced to an industrialized global market. The core is much deeper, acting provides a more optimistic way of looking at the future, reframing human desires as opportunities.

Thus, inherent to the objective proposed in this article is the premise that using design tools it is possible to intervene in the process of valorization and visibility of Pernambuco's crafts, aiming at the sustainability of the sector. The artisans of the Flor do Barro group declared the need to take ownership of new collective production routines, exploring different techniques, tools and machinery not explored in the community. Therefore, a new thought is planned that modifies the process of ways of making, and that, at the same time, is aligned with the sustainable maintenance of its artisanal activity and that allows the permanence of the manual ceramic tradition.

Therefore, below is the result of the Ceramic Design Workshop with women artisans, which aimed to promote creativity and a feeling of collective belonging. The challenge was to make them give new meaning to their

view of clay around a theme that had not yet been worked on by the community, Territorial Jewels.

The context of jewelry, by definition, is linked to the implicit value of the material, production and crafted with precious metals. The selection of less noble materials with low environmental impact has given rise to a new market parallel to that of traditional jewelry, artisanal jewelry, which is treated, from now on, as "territorial jewelry".

The term characterizes the artifact that carries traditional techniques, local raw materials, in addition to concepts and themes that portray different cultural aspects of the region. And, therefore, it brings together the preciousness of the jewelry and the territorial references of craftsmanship (GONÇALVES et al, 2023).

## 2. METHODOLOGICAL PROCEDURES

The Ceramic Design Workshop is one of the strategic actions to bring design closer to crafts, and the result of the extension action to map the crafts production chain of the Flor do Barro group. The methodological foundation is in the productions of the UFPE Design Laboratory O Imaginário, which aims to meet demands linked to crafts and industry, integrating extension, teaching and research, within five axes: management, production, design, communication and market (ANDRADE; CAVALCANTI, 2020). The workshop arises from the desire of women artisans to test their skills with clay, through new production techniques and directs attention to the dichotomy between their individual work and collective thinking.

This paradox confronts the artisans' format of action and the common discourse interested in exploring new techniques and forms. The creation of a collection of territorial jewelry appears as a means proposed by the artisans themselves, which socially represents the desire to follow new paths coexisting with traditional local figurative art and the strengthening of the feminine positioning of Flor do Barro group. Therefore, the workshops were planned with the aim of giving new meaning to women's relationship with clay.

Reflection on this expansion of artisans' interests can be associated with Andrade's (2015, p. 80) approach to the local-global relationship. The author confronts the concept of development and culture based on the reality of handicraft producing communities. To this end, she quotes Aloísio Magalhães (1927-1982) and his phrase: "Homogeneity is untrue", indicating the idea of globalization as a result of pluralism, respect for differences and the fight against cultural monopolies. As well as the strength that Aloísio attributed to those coming from popular knowledge, as "it is from them that the potential is gauged, the vocation is recognized and the more authentic values of a nationality are discovered" (Andrade, 2015, p. 81).

Recognizing and valuing the vocation of a people allows development work in a locality, that is, economic dynamism and improvement in the community's quality of life. This can occur by exploring social opportunities and, at the same time, conserving traditions and natural resources, as these are possibly the foundation for the vocation.

In this sense, it is pointed out that from the producers' point of view, the designer can systematize the production processes and identify the values of craftsmanship. This is a meeting of mutual and feedback interest.

In this article, design tools such as: ideation, generation and selection of alternatives, execution planning and collection detailing, prototyping and testing were detailed in a work plan that included creativity workshops, shape studies, assemblies, painting and finishes. Figure 1.

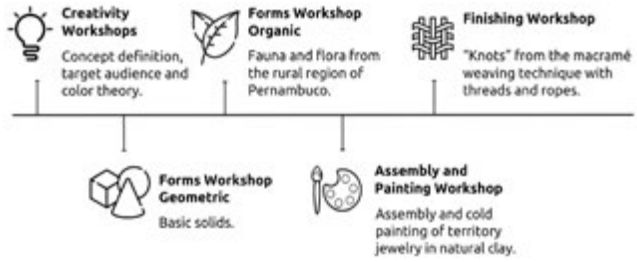


**Figure 1:** Diagram of the workshop process.
**Source:** Authors.

The workshops took place in an immersion with the artisans for three days, in November 2022, at the group's headquarters in Alto do Moura, in Caruaru. Aiming to expand the visual and symbolic repertoire of the artisans and collaborate in the creation of the collection concept and reflection of the target audience.

The study of colors aimed to present the colors and the principles that govern their relationships in a spatial structure (surface, depth, fusion and tension) and was inserted as creative programmatic content to explore the different possibilities of uses and harmonies. To this end, harmony schemes were studied based on the color circle and the cultural and contextual variations in the symbolic and emotional meanings of colors.

Still in the creativity workshops, chromatic hues and their qualities were explored based on lighting and color temperature. As for saturation, the purity and intensity of the hues were worked on. With different shades of gray and mixtures of primary and secondary colors, the artisans made saturation adjustments which created different visual effects and could be related to the clay applications and target audiences.

An analysis of similar items, with handcrafted ceramic jewelry from different countries, was presented as a teaching resource for geometric and organic shapes workshops, presenting the bases for formal principles (LUPTON and PHILLIPS, 2008). This tool sought to identify visual elements, concepts or design solutions similar to the theme being worked on. The organization of the products found allowed discussions about trends, inspirations, elements of nature, and technological solutions.

The aforementioned analysis includes thirteen different producers from the Americas, Europe, Asia and Africa. It is available in its full version at the following data storage link: https://drive.google.com/file/d/1jyiXu3JClDdk-jkAnm_UpY3JZxqi5oQS/view.

Also summarized in figure 2.

**Figure 2:** Diversity of ceramic adornments around the world.
**Source:** Authors.

The assembly, painting and finishing workshops were planned as a process of creative immersion.

**Figure 3:** Video lesson showing the application and creation of knots to close the pieces.
**Source:** Authors.

The macramé knotting technique was selected for the closures and finishes of thepieces. Video lessons were produced to instruct how to manufacture the parts, which are available on the online video sharing platform, YouTube, with free access through the links:
https://www.youtube.com/watch?v=ZKMQS1myKCo
https://www.youtube.com/watch?v=Q-hJZozuQeo

## 3. RESULTS

On the first day of the Workshop, a dialogue took place between the artisans and the technical team of the extension project about how and for whom they could normally create their pieces. This conversation took place with the support of printed magazines to recognize the target audience of the jewelry they would like to create. This part was dedicated to the target audience identification exercise.

The first creativity workshop proposed was to prepare a moodboard or semantic panel, which is a visual tool whose purpose is to convey concepts and project proposals.

The perception of being able to create pieces, for a population different from those they usually live with in their own community, was understood as positive by all the women in the group. The technique of observation and cutting out magazines with images of people who might like the pieces they want to produce was used. An image panel was assembled by category: person, environment, customs, objects, etc. The artisans had to imagine a type of person or customer and define their name, profile, housing, clothing, habits, objects they like, etc.

After a discussion regarding the images they selected, a moment of collective collage on A3 paper was proposed. And after studying the target audience, an introductory conversation was held about the study of color, color circle, types of combinations, mixtures of hues and lighting variations. Figure 4.

**Figure 4:** Content exhibition on target audience definition and color theory.
**Source:** Authors.

The artisans initially tested the color assembly process by mixing hues. Next, they explored the lighting possibilities of their chromatic creations with gray levels. Several color palettes were generated, all with records of their compositions. Figure 5.

**Figure 5:** Integrated moodboard composition: target audience and color theory.
**Source:** Authors.

The geometric shapes workshop proposed to expand the group's figurative repertoire, starting from basic shapes (triangles, circles, squares and rectangles), took place on the second day of the event. The artisans of the Flor do Barro group already have the ability to manually model free anthropomorphic figurative forms, and wanted to try new manufacturing techniques with clay, such as flat modeling.

The geometric shapes in the clay were made with the help of manual tools such as knives, box cutters and also objects available in their homes such as: PET bottle caps, cups, basins and others that enabled this configuration of basic shapes. Figure 6. It is known that the construction of artifacts based on materials available on site improves productivity, the generation of alternatives, learning and makes these workshops a more playful and practical moment.

**Figure 6:** Study of geometric shape in clay.
**Source:** Authors.

**Figure 7:** Study of organic form with the theme of flora and fauna from the Agreste region of Pernambuco. **Source:** Authors.

Still on the second day, geometric studies were associated with the observation of the organic nature of the flora of the Agreste region where they live. The artisans were invited to look closely at the surroundings of Alto do Moura and understand which plant forms are characteristic of the region. Figure 7.

They selected several seeds, leaves and fruits that became formal references, stamps and other work tools. After this action, they returned to modeling in their usual organic areas, however, outside the universe of anthropomorphic forms. Several types of vegetation, native seeds and even their bodies (forearms) were used as tools to create subtle curves for the pieces. Figure8.

**Figure 8:** Color study and application in shapes.
**Source:** Authors.

The last day of the workshop was dedicated to assembling, painting and finishing the pieces. The production of both shape workshops was exposed to the large group and it was suggested that the pieces be composed individually. As a practical activity, the artisans were instructed to think and produce a prototype of the product that would be an object of interest to the customer, which they had already defined in the previous workshop. They should justify the choice of the product and show why it would be of interest to that customer.

Each artisan needed to choose the elements to make up their jewelry and, with the support of a blank A4 sheet of paper, distribute them to make up a set consisting of a necklace, earrings or bracelet. The strategy of composing the pieces with both geometric and organic shapes was the biggest challenge for everyone. It was observed that each artisan has their own preferences in composing the sets, and this way of expanding the variables proposed in the studies of form occurred with great enthusiasm and the desire to recreate countless times.

An internal and collective curation, composed of all the artisans participating in the Workshop, was proposed to select the pieces that would make up the Group's Portfolio. Color study exercises were revived and the artisans were able to finish painting their pieces. Figure 9.

**Figure 9:** Color study and application in shapes.
**Source:** Authors.

In the final stage, the macramé knotting workshop took place with the aim of presenting alternative fastening systems using natural material, threads and cords. Figure 10. Initially, a theoretical class was given on some knots with quick, practical and adjustable closure. Afterwards, an immersion was carried out to facilitate the artisan's skill and resourcefulness. This moment of recreating experiences related to macramé provided an understanding of uniting the production already carried out (beads and clay pendants) into a whole, with easy techniques that enabled understanding for a significant step by step. Having this teaching that covers new teaching methods regarding the finishing of the piece was essential to achieve a fit that enhances the value of the jewelry.

In this way, the constructive results in the pieces aimed to propose a format that mixed clay and threads, providing a compilation of craftsmanship from beginning to end. It was also observed that the artisans repeated the knot closing process several times, and with this rhythm

of trying multiple times, they concluded a positive and satisfactory production.

**Figure 10:** Study of knots and shape composition
**Source:** Authors.

Macramé is an ancient weaving technique that involves tying knots together, forming a whole. It is suitable and widely used for various compositions in crafts, mainly in bags, necklaces, bracelets, curtains, streamers, etc. The knots for bracelets and necklaces were presented on site and also made available on video for training, as mentioned in topic 2 - Methodological Procedures.

The territory jewelry prototypes were assembled individually with elements created collectively. The culminating moment of the Workshop was the photo session of the territory jewelry created and tested by the women of the Flor do Barro group. Figure 11.



**Figure 11:** Tests of the Flor do Barro territory jewels group.
**Source:** Authors.

## 4. DISCUSSIONS

Overall, the participating artisans perceived the Ceramic Design Workshop as positive. During the evaluation of the work, some statements were collected, such as the group's leading artisan: "It's an extra level of creativity, because we spend our whole lives, 60 years, just working figuratively, right? It's very important, it's cool because it's another art."

> One of the artisans declared:
> "It's a great discovery, a wonderful learning experience. It's another thing to understand that today we are making jewelry, we are not making figurative art, but rather jewelry with the colors that we learned here, suitable precisely for Flor do Barro jewelry (...) It's thanks to getting out of the figurative, utilitarian routine, it's an additional creation, so this is challenging and very rewarding."

They also spoke about the importance for new generations who no longer show interest in traditional crafts: "(...) we can bring along little people who will come, so that tomorrow they can say, if they, with sixty-somethings, could create all this wonderful stuff, then we can too".

From a technical perspective of the process, the project limitation lies in the composition of the ceramic mass. The clay usually used in the production of ceramic pieces from Alto do Moura has low mechanical resistance and is not resistant to high firing temperatures, that is, with little refractory material in the composition. The surface treatment process with the application of ceramic enamel was not possible, so the Territory Jewels were only assembled with a cold paint finish, synthetic enamel.

Ceramic enamels are surface treatments based on natural glazes and oxides that improve the mechanical resistance of pieces and add color and value to the material. However, as it is a ceramic technology, it requires specific equipment, materials and procedures, such as high firing temperatures (>900°C).

The explanation above emphasizes that in a second workshop it is necessary to use refractory clay, plus inorganic material, capable of receiving medium temperature ceramic enamel (900 - 1100°C) and the use of furnaces with greater heat capacity for sintering the pieces, up to and the use of furnaces with greater heat capacity for sintering the pieces, up to1300°C.

## 5. FINAL CONSIDERATIONS

Despite the difficulties due to the pandemic situation during the period of carrying out the activities, this project had its relevance related to bringing design closer to craftsmanship through immersion in the reality of a ceramics group composed only of women. The general objective of the project was to propose, through design, resource valorization strategies for the production and commercialization of the Flor do Barro group in Alto do Moura, Caruaru.

Expanding target audiences is a possibility for the Flor do Barro group brand to be recognized. In addition to the objectives outlined in the extension actions, a reflection that accompanied the entire course of the project refers

to the controversial reconciliation of design with crafts. In addition to the objectives outlined in the extension actions, a reflection that accompanied the entire course of the project refers to the controversial reconciliation of design with crafts. Although it already seems to be academically surpassed, it was clear that the Flor do Barro group does not understand it this way because during the debate the artisans demonstrated total interest in new ways of creating, which go beyond the tradition of figurative art from Alto do Moura.

In this regard, we conclude that design acts as a tool for strengthening artisan groups in Brazil, providing ways of more positive actions to consolidate women's collective thinking, reformulating collective desires as opportunities. Therefore, an artifact can be understood as a cultural product if it reveals its materiality, values, meanings and techniques, referring to the space and time in which it was produced.

Regarding the risk of intervening in artisanal work, Janete Costa (1932-2008) defends that: "this risk will always exist", considering that the artisan, like a large part of society, is also sensitive to changes. "It's up to us to ensure that they don't lose their cultural continuity, but I think we have to take that risk." To this end, the architect from Pernambuco assigns the designer the responsibility of deeply understanding "the spirit of tradition", with the aim, above all, of improving their income and living conditions. "It's interfering without hurting."

The creative experience with the group expanded the recognition of the territorial vocation and, with it, the opportunities for economic dynamism and improved quality of life for women in the community. The effectiveness of the "design and craftsmanship" relationship lies in conveying to the products the particular authenticity of the culture in which the producers are immersed. This concept, authenticity, refers to the unique way in which each artist or artisan sees the world around them and is able to represent it or express their feelings or emotions.

## REFERENCES

ANDRADE, Ana Maria Queiroz de. **A Gestão de Design e os Modelos de Intervenção de Design para Ambientes Artesanais: um estudo de sobre a atuação do Laboratório de Design O Imaginário/ UFPE nas comunidades produtoras Artesanato Cana Brava – Goiana e Centro de Artesanato Wilson de Queiroz Campos Júnior - Cabo de Santo Agostinho, Pernambuco.** Tese apresentada ao Programa de Pós-Graduação em Design. UFPE, Recife, 2015.

ANDRADE, A. M. Q. DE.; CAVALCANTI, V. P. Laboratório **O Imaginário: uma trajetória entre design e artesanato.** Recife: Zoludesign, 2020.

BARBOSA, A. C. DE M. **CADA LUGAR NA SUA COISA: Um estudo sobre os suvenires do Alto do Moura através da dimensão semiótica do design e da cultura turística.** Tese (Doutorado em Design) - Universidade Federal de Pernambuco. Recife, 2019.
Entrevista concedida por A CASA. Biblioteca - JANETE COSTA (1932 – 2008). Entrevistador: Daniel Douek. Publicado em 8 de agosto de 2008, em http://www.acasa.org.br/biblioteca/texto/176. Acesso em julho de 2018.

Gonçalves, V., Silva, G. D. A., & Benatti, L. P. (2023). Joia de Território no Estado do Pará: uma análise da cadeia produtiva dos adornos com sementes nativas: **Territory Jewel in the state of Pará: an analysis of the productive chain of adornment with native seeds.** IX Sustentável, Mix Sustentável (edição especial ENSUS 2023), 9(4), 113–124. https://doi.org/10.29183/2447-3073.MIX2023.v9.n4.113-124

LUPTON, Ellen; PHILLIPS, Jennifer Cole. **Novos fundamentos do design.** Tradução de Cristian Borges. São Paulo: Cosac Naify, 2008.

SANTOS, Jessyane Alves dos; MELO, Camila Wedja Francisco de; SILVA, Germannya D Garcia Araujo; BARBOSA, Ana Carolina de Moraes Andrade. **Mapping of the Handicraft Productive Chain as a sustainability tool the Flor do Barro Group - Alto do Moura - Pernambuco / Brazil.** Anais do XI Encontro de Sustentabilidade em Projeto - ENSUS, p. 519 a 529. Florianópolis, junho de 2023.

SANTOS, Marília Brandão da Silva; BARBOSA, Ana Carolina de Moraes Andrade; SILVA, Germannya D' Garcia Araújo. **The Look of Design on Narrative Ceramics from Grupo Flor do Barro - Caruaru/PE.** MIX Sustentável, v. 8, n. 2, p. 143-153, mar. 2022.

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# MAT-SUS: MATERIAL LIBRARY FOR TEACHING, RESEARCH AND EXTENSION

## *MAT-SUS: PROJETO DE MATERIOTECA SUSTENTÁVEL: ENSINO, PESQUISA E EXTENSÃO*

## *MAT-SUS: ROYECTO DE BIBLIOTECA SOSTENIBLE: DOCENCIA, INVESTIGACIÓN Y EXTENSIÓN*

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**ABSTRACT**
This article shows teaching, research and extension actions focusing on the use of materioteca. The main objective is to promote the dissemination of sustainability knowledge in projects, taking as a starting point the material selection process. This article presents a materioteca with a new concept, where in addition to samples of materials and technical information, it presents a complete report on the economic, social and environmental sustainability of each material (ESA). Complementary extension actions include the development of comics, videos, models and prototypes. The initial results of the present research demonstrated that it is possible to provide designers with an analysis of the relative sustainability of each material compared to similar ones, providing a very relevant set of design information.

**KEYWORDS**
Materials, Sustainability, Research, Teaching, Extension.

***RESUMO***
*Este artigo aborda ações de ensino, pesquisa e extensão com foco no uso de materioteca. O objetivo principal é a promoção e disseminação do conhecimento da sustentabilidade em projetos, tendo como contexto norteador o processo de seleção de materiais. Apresenta-se a MAT-SUS, materioteca com um novo conceito, onde além de amostras de materiais e informações técnicas, apresenta-se um relatório completo sobre a sustentabilidade econômica, social e ambiental de cada material (ESA). Em paralelo, ações de pesquisa e extensão incluem o desenvolvimento de HQs, vídeos, modelos e protótipos. Os resultados são todos agrupados em site próprio, fornecendo aos projetistas uma análise da sustentabilidade relativa de cada material em comparação com outros similares, proporcionando um conjunto muito relevante de informações projetuais.*

***PALAVRAS-CHAVE***
*Materiais, Sustentabilidade, Pesquisa, Ensino, Extensão.*

***RESUMEN***
*Este artículo muestra acciones de enseñanza, investigación y extensión teniendo como foco el uso de materioteca. El objetivo principal es promover la difusión del conocimiento de sostenibilidad en proyectos, tomando como punto de partida el proceso de selección de materiales. Este artículo presenta una materioteca con un nuevo concepto, donde*



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*además de muestras de materiales e informaciones técnicas, presenta un informe completo sobre la sostenibilidad económica, social y ambiental de cada material (ESA). Las acciones de extensión complementarias incluyen el desarrollo de cómics, videos, modelos y prototipos. Los resultados iniciales de la presente investigación demostraron ser posible proporcionar a los diseñadores un análisis de la sostenibilidad relativa de cada material en comparación con otros similares, proporcionando un conjunto muy relevante de informaciones proyectuales.*

***PALABRAS CLAVE***
*Materiales, Sostenibilidad, Investigación, Enseñanza, Extensión.*

## 1. INTRODUCTION

The project encompassing sustainability is already a reality, where the philosophy of continuous improvement is united with the increasing need to preserve natural resources, human quality of life, and current capitalism. This article shows an implemented proposal to contribute to this, using the concepts of material choice and sustainability triad, represented by the economic, social, and environmental dimensions.

As Ashby and Johnson (2011) comment, classification is the first step in bringing order to any scientific endeavor; it segregates an initially disordered population into groups that somehow have significant similarities. Because product design is a multidisciplinary activity, in essence, classification plays a very important role. "Design involves choice, and a choice is made from a huge range of ideas and data - among them, the choice of materials and processes" (ASHBY; JOHNSON, 2001, p. 123). Therefore, it is essential to this area that the classification occurs through a material library, a starting point for further analysis, such as performance in terms of comparative sustainability between materials.

Giorgi (2012) proposes material libraries as relevant structures whesre designers and designers can find innovative materials and technologies to increase their industrial projects and processes. In the educational field, material libraries contribute to professional training and practice in design, as they allow access to information for students and young professionals to expand their repertoire and knowledge.

In this case, the material library presented here is divided into the physical material library (material library itself), composed of different samples, the virtual material library (where traditional analyses and links with sustainable issues are present), and the construction library (models and prototypes demonstrating materials and related manufacturing techniques). Support actions include designing materials and processes in the format of Comic Stories and academic production of videos on materials and processes

## 2. REFERENCIAL

This project started in 2010, based on the ESE model found in Librelotto (2009), and was initially used for sustainability analysis in the construction industry. In this model, through the joint analysis of market pressures, given the performance and conduct, companies were classified according to predetermined terms: defeated, suffering, indifferent, responsible, opportunistic, and pioneering. In addition to the author's direct application in her doctoral thesis, the model was later used in two master's dissertations and several case studies, always with an initial focus on civil construction.

With the results obtained, analyzing the potential demonstrated in these case studies, Ferroli and Librelotto (2011) proposed to apply the ESE model in the analysis of the sustainability of the materials used in the manufacture of physical products for design (volumetric models and prototypes), adapting the method according to the specificity of the area. Thus, the performance axis evaluated the economic criterion of sustainability, the conduct axis evaluated the environmental criterion of sustainability, and the pressure axis evaluated the social criterion of sustainability. The position taken by the material used in the model or prototype in the cube determined the degree of "sustainability" according to a broad approach, covering the three variables: economic, social, and environmental.

From this, in 2012, the construction of the material library began with an emphasis on sustainability, starting with samples already available in the course laboratories. With resources from the project "Material Library with Emphasis on Sustainability a New Approach to the Selection of Materials Applied to the Project" of the PROEXT MEC SESU program, 2014, new samples and even part of the furniture were acquired. From then on, the maintenance of the physical part and preparation of the records of each material are carried out by scholarship holders, usually linked to the PIBIC-CNPq or Probolsas da Universidade program, renewed annually.

Based on the theoretical framework acquired in the initial projects, the constant bibliographic research was established as a starting point for permanent updating of the state of the art of the referred problem, followed by field research (visits to fairs, events, congresses, etc. whose subject addressed new materials and manufacturing processes). Each new scholarship student to the project must become familiar with the standard procedures for the synthesis of information, composition of sustainability variables, preparation of material classification requirements due to sustainability, study of the groups of materials in which the analyses were carried out, preparation of tests and sample validation procedures.

In the initial part of the research, the variables to be considered and their possible consequences were determined. These were modified and/or increased over time, always obeying possible and applicable measurements in real design situations. Due to the theme addressed, it was necessary to work with qualitative and quantitative variables, as well as those that, in a way, can be called mixed (neither thoroughly qualitative nor quantitative)

According to Severino (2007), the correct procedure in these cases is to refer to research as a qualitative or quantitative approach because, through these designations, one can refer to several methodological sets emphasizing one or the other approach. This is because it is difficult to conclude one purely qualitative or purely quantitative research, as happens especially when considering more heterogeneous groups, such as polymeric mixtures, mixed composite materials (natural and synthetic in the same block), or similarities/particularities of natural materials, with their various species, types, and groups.

## 3. PROJECTS

### 3.1 Physical Material Library



The project activity, especially in design, is based on project methods. Regarding selecting materials, it can be challenging to determine the best approach for a project. This primarily depends on first identifying the actual problem of the project that needs to be solved. It involves complementary factors such as project team, previous knowledge, and method style preference (open, closed, semi-open).

The team in practical cases is often heterogeneous, which will bring an advantage and a better perception of the overall project. Therefore, a heterogeneous team is understood not only to be formed by professionals from different areas of graduation or specialization but also from different expertise. This is a limiting factor, and even an impossibility, in academia, especially in undergraduate courses, since they are usually people from the same class. There are exceptions in graduate studies, in design disciplines, where there are students from various basic backgrounds, such as engineering, design, architecture, etc.

There is a consensus among the various design methodologies that there are three specific periods: pre-conception, conception, and post-conception. In particular methods, the word design replaces conception with the same principle. The design team, aware of its qualities and diversities, must analyze the available methods and verify which will bring better results with less expenditure of resources (human, financial, structural, among others). In general, applying a design method effectively requires the simultaneous use of design tools, quality tools, and creativity techniques.

The method of Santos (2017), for example, allows greater freedom to the design team, while the method of Rozenfeld and others (2006) and Baxter (2011) present a more traditional and systematic structure. Due to the focus of this article, a detailed study of the design methods will not be carried out, and the bibliography on this aspect is quite rich for those interested. In part, the more "open" or "closed" nature of the design methods can be explained by the origin of the original training of the authors of each method. Those with design training usually use primarily qualitative approaches, while those with engineering training use quantitative approaches more frequently.

Another noteworthy feature is that methods considered “open ”allow material choices to be carried out in several steps. This resulted in the evolution of the MAEM-6F method (Material Choice Method in 6 Factors) to the FEM (Material Choice/Selection Tool) because as the end of the project approaches, the definitions will be more specific and increasingly definitive. So, the "choice" of materials is made: ferrous metals or processed wood, for instance. In this process of choosing, there is not a more technical definition yet. From then on, previously chosen materials are selected, such as defining AISI 304 stainless steel (ferrous metals) or MDF HD (processed woods).

The selection itself can begin with the analysis of materials that suit a common purpose (for example, flexible laminate, multilayer carton, glass, or polyethylene for packaging fruit juice), followed by the comparison of the appropriate production processes before making the final choice, thus adapting the processes to the materials (ASHBY; JOHNSON, 2011). Finally, one can work with a material already determined, where the knowledge of the materials will be valuable for defining processes of the product to be developed when proposing associations with other materials and planning its life cycle.

Akin and Pedgley (2015) relate this to the fundamental aspects necessary for a material library: (a) operational profile; (b) purpose and public; (c) content; (d) structure and form of display; (e) cataloging system, searching the collection and providing information about the materials. Different paths can be taken in each of these points, and the set of these decisions defines the characteristics and

functioning of the material library.

In a continuous process of assembly (by the acquisition of new materials), the physical part of the material library is located on the UFSC campus, in the Department of Architecture and Urbanism, next to Virtuhab, with free access to students, especially in areas related to product design activities, such as engineering, architecture and urbanism and design.

In this part, in addition to the samples themselves, reports have been made available containing properties, characteristics, application examples, demonstrations, etc., of the various groups of materials. The related activities integrate the research of new materials and new manufacturing processes, cataloging existing ones, and the development of catalog sheets with the life cycle of each material (virtual part). Scholarship students of the project also participate in material exhibition activities (at fairs and events) and visits to schools, aiming at initiating materials for young students, emphasizing the environmental issues of each material, such as degradation, energy consumption, recycling, and reuse possibilities, among others.

As shown in Figure 1, used for exemplification, the material samples preferably all have the same size (perimeter and thickness). When possible, they were obtained in this way to facilitate observations by the user, such as the relative weight between one type of material and another. Part A Figure 1 shows several different types of natural and processed wood. By simple tactile experimentation, students can compare the characteristics of each material, such as relative weight, texture, color, surface hardness, and others. In the case shown Figure 1, another advantage noticed is the possibility of comparing the cross-sections of different materials.

A common problem in material libraries, especially academic ones, refers to physical space, which is usually limited. Virtanen et al. (2017), by some means, touch on the subject when commenting on the differences between the material libraries considered "commercial" and the academic ones. In commercials, it is typical to have two types of which, in both cases, access is generally restricted to members and commonly involves a financial part, charging visitation or association fees via monthly payments. The other types of commercial libraries are those linked to manufacturers and suppliers of materials, practically with the same characteristics as the previous ones but with restricted use.

There are also material libraries called private or professional "collections", which are usually set up and maintained by offices or companies, and alike have restricted access, directed to employees. Institutional or academic material libraries, on the other hand, usually have an educational profile and are organized by research groups or courses. In the case shown in this article.

**Figure 1:** Physical part of the material library.
**Source:** Omitted for review.

### 3.2 Material library with an emphasis on sustainability – virtual part of the material library y

The virtual part of the material library is where users find the general data of the samples and their relationship with the emphasis on sustainability, where it seeks to relate the process of choosing the materials with the factors listed in Librelotto et al. (2012), where the process is based on:

- Manufacturing and productive factors;
- Market and social factors;
- Economic and financial factors;
- Aesthetic and general presentation factors;
- Ergonomic and general safety factors;
- Environmental and ecological factors.

The objective is to fill the gap in the current existing material libraries by providing the user with, in addition to samples and reports containing properties, characteristics, application examples, demonstrations, etc. (common to existing material libraries), the analysis of the sustainability of said material, compared to other materials directly competing for each specific application. This analysis includes social, economic and environmental aspects.

Figure 2 exemplifies the digital part of the sustainable material library. This web page contains didactic material, which complements the physical samples made available in the laboratory. In practice, students find in the virtual part of the material library the following information about each material: concept, history, specific properties, physicochemical properties, thermal properties, mechanical properties, classification, production processes, manufacturing processes, main uses, disposal, recycling, sustainability analysis, and leading suppliers. The last image of the figure shows an example of the report, which is all produced with the same graphic design.


**Figure 2:** Virtual part of the material library.
**Source:** Omitted for review.

### 3.3 Complementary projects to the material library

During the years of use of the material library, some projects were developed as users identified new needs. Among these needs, the following stand out:

1) Construction of models and prototypes. The models and prototypes are built in specific classes, with the participation of both regularly enrolled undergraduate and graduate students and others through extension actions. Figure 3 shows four of these models. The first is a prototype built with bamboo and was carried out in a practical workshop with the participation of undergraduate and graduate students, together with extension workers and researchers. The second is a prototype made with resources from a research project. This is a "floating" house intended for areas of potential flood risk. Its construction was outsourced, but the operational tests were all carried out in experimental classes. The third image shows a steel frame construction, whose material was donated by the company Center Steel, with the construction carried out in an experimental class, and the fourth image is of a wood frame, whose material was donated by MF Madeiras, with construction also in an experimental class.

**Figure 3:** Construction Library Projects.
**Source:** Omitted for review.



2) Availability of the content of materials and manufacturing processes in HQ format. It is the development of a series of publications for teaching sustainable materials and processes that meet the demands of a new generation of design students in the form of comic books. For the teaching of materials applied in the products, combining it with sustainability requirements, an approach that reaches the target audience (students related to the project areas) more forcefully and follows the communication language of the stakeholders and decision-makers became urgent and necessary. Although communication associated with comics is not recent, such an approach for didactic purposes is not common yet, especially when integrated into the virtual environment and the teaching/learning of materials applied to projects. The project is already in its second year, and Figure 4 illustrates some images.

The first image of Figure 4 shows a general process application in choosing materials; the second image refers to the classification of materials usually used; the third and fourth images address the study located in a material, in this case, ceramic. The other materials are still being designed.

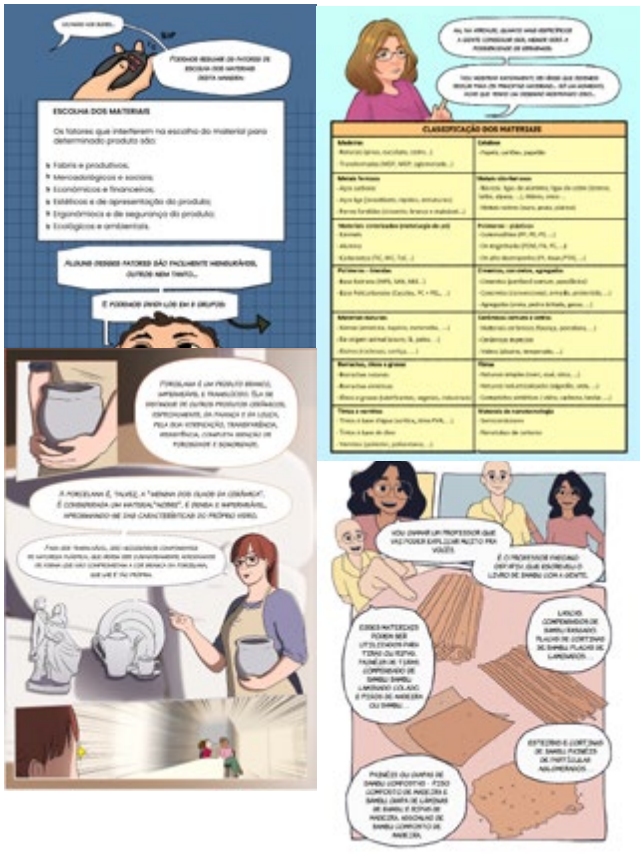


**Figure 4:** Material content and processes in comics format.
**Source:** Omitted for review.

3) Development of didactic videos on materials and processes. The videos are developed by the students of the participating classes, with guidance in the classroom. They are presented, corrected, and made available on the website if authorized by the authors. The first image in Figure 5 shows how the videos are made available, and the second image presents an example of a video.


**Figure 5.** Complementary actions - videos.
**Source:** Omitted for review.

## 4. FINAL REMARKS

The article aimed to show some projects developed within the scope of the laboratory (omitted for evaluation) of UFSC (Federal University of Santa Catarina), focusing on projects linked to the material library.

The need for a material library (in its physical and virtual versions) is confirmed when one understands the process of choosing such to be more than considering technical and productive attributes. A good product must meet the needs of all user groups, involving productive, economic, ergonomic, social, environmental, and aesthetic aspects, and the materials suitable for this model must all comply.

The complementary projects of videos, comic book production, and construction/assembly of prototypes have proved, over the years of application in undergraduate and graduate classes, to be an essential didactic resource, along with an integrating element between research, teaching, and extension. Mainly because all workshops offered for teaching purposes are prepared or presented by extension or scientific initiation students, in addition to the supervision of master's and doctoral students.

## REFERENCES

AKIN, Fazil; PEDGLEY, Owain. Sample libraries to expedite materials experience for design: A survey of global provision. **Materials & Design**, v. 90, p. 1207-1217, 2016. DOI: 10.1016/j.matdes.2015.04.045

ASHBY, Michael; JOHNSON, Kara. **Materiais e Design** – Arte e Ciência da Seleção de Materiais no Design de Produto. Rio de Janeiro: Elsevier, 2011.

BAXTER, Mike. **Projeto de Produto**. 3. ed. São Paulo: Edgard Blücher Ltda, 2011.

FERROLI, Paulo Cesar Machado e LIBRELOTTO, Lisiane Ilha. **Modelagem Física com Instrumento de Análise da Sustentabilidade no Design de Produtos.** EGR-CCE-UFSC, 2011 (relatório de pesquisa).

GIORGI, Claudia De. Materiais para design. Inovação em pesquisa e didática no Politecnico di Torino. In: DE MORAES, D.; IIDA, I.; DIAS, R. A. (Org.). **Cadernos de Estudos Avançados**: inovação. Barbacena: EdUEMG, 2012, p. 37-51.

LIBRELOTTO, Lisiane Ilha. **Modelo para Avaliação de Sustentabilidade na Construção Civil nas Dimensões Econômica, Social e Ambiental (ESA):** Aplicação no setor de edificações. São Paulo: Blucher Acadêmico, 2009.

ROZENFELD, Henrique; FORCELLINI, Fernando Antônio; AMARAL, Daniel Capaldo; TOLEDO, José Carlos de; SILVA, Sérgio Luis da; ALLIPRANDINI, Dário Henrique; SCALICE, Régis Kovacs. **Gestão de Desenvolvimento de Produtos** – Uma Referência para a melhoria do processo. São Paulo: Saraiva, 2006.

SANTOS, Flávio Anthero Nunes Viana dos. **Método de Desdobramento de Três Etapas.** http://md3e.com.br. 2017. <Acesso em setembro de 2021>

SEVERINO, Antônio Joaquim. **Metodologia do Trabalho Científico.** 23 ed. São Paulo: Cortez, 2007.

VIRTANEN, Maarit; MANSKINEN, Kati; EEROLA, Sauli. Circular Material Library. An Innovative Tool to Design Circular Economy. In: **The Design Journal,** v. 20, n.1, p. 1611-1619, 2017). DOI: 10.1080/14606925.2017.1352685

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# THE HOUSING FIRST PROGRAM: ACTING FOR BOP DESIGN

## *O PROGRAMA MORADIA PRIMEIRO: ATUAÇÃO NO DESIGN PARA A BASE DA PIRÂMIDE*

## *EL PROGRAMA VIVIENDA PRIMERO: ACTUACIÓN EN EL DISEÑO PARA LA BASE DE LA PIRÁMIDE*

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**ABSTRACT**
This article explores the social aspect of Sustainable Design and investigates the potential of implementing the Housing First (HF) philosophy as public policy. The HF philosophy is a form of Design for the Base of the Pyramid (BoP) that aims to include homeless people in the community, promoting equity and social cohesion. This research paper's theoretical foundation describes BoP Design concepts and relates them to the HF service through a bibliographic review of authors who discuss these definitions. The article also provides context to the subject in Brazil and analyzes the Moradia Cidadã program, which utilizes the Housing First concept. Additionally, the article explores the Low Income Housing Institute (LIHI), located in Seattle, and more specifically, its Tiny House Villages program. After discussing the organizational and project guidelines proposed by these programs, the information collected is compared and associated with the social context of Brazil.

**KEYWORDS**
Sustainable Design; Base of the Pyramid; Housing First; People Living on the Streets; Moradia Cidadã Program.

***RESUMO***
*Considerando a dimensão social do Design Sustentável, este artigo tem como objetivo verificar as possibilidades de implementação da filosofia Housing First (HF) como política pública, visto que se caracteriza como uma forma de atuação do Design para a Base da Pirâmide (BoP) que favorece a inclusão da população em situação de rua na comunidade, proporcionando equidade e coesão social. A fundamentação teórica descreve os conceitos do Design BoP relacionando-o com o serviço de HF por meio de revisão bibliográfica de autores que tratam destas definições. Em seguida, é realizada a contextualização do assunto no Brasil, bem como análise do programa Moradia Cidadã, que utiliza o conceito de Moradia Primeiro. Também é feita análise da organização denominada Low Income Housing Institute (LIHI), localizado em Seattle, mais especificamente o programa Tiny House Villages. Após discussão sobre as diretrizes organizacionais e projetuais propostas por eles, as informações coletadas são comparadas e associadas ao contexto social do Brasil.*

***PALAVRAS-CHAVE***
*Design Sustentável; Base da Pirâmide; Moradia Primeiro; População em Situação de Rua; Moradia Cidadã*



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## *RESUMEN*

*Considerando la dimensión social del Diseño Sostenible, este artículo tiene como objetivo verificar las posibilidades de implementar la filosofía Housing First (HF) como política pública, ya que se caracteriza como una forma de Diseño para la Base de la Pirámide (BoP) que favorece la inclusión. de la población sin hogar en la comunidad, brindando equidad y cohesión social. La fundamentación teórica describe los conceptos del Diseño BoP relacionándolo con el servicio de HF a través de una revisión bibliográfica de autores que abordan estas definiciones. A continuación, se contextualiza el tema en Brasil, así como se analiza el programa Moradia Cidadã, que utiliza el concepto de Vivienda Primero. También se hace un análisis de la organización denominada Low Income Housing Institute (LIHI), ubicada en Seattle, más específicamente el programa Tiny House Villages. Después de discutir las directrices organizativas y de proyecto propuestas por ellos, las informaciones recopiladas se comparan y asocian con el contexto social de Brasil.*

## *PALABRAS CLAVE*

*Diseño sostenible; Base de la Pirámide; Vivienda primero; Población sin hogar; Programa Moradia Cidadã.*

## 1. INTRODUCTION

In the realm of sustainable design, the social component is marked by disparities and transgressions against fundamental human rights. The demographic residing at the base of the worldwide economic hierarchy is highly varied, with a significant proportion experiencing dire poverty, fractured familial relationships, and inadequate housing accommodations. Consequently, these individuals are compelled to seek shelter in public locales, which are frequently inhospitable and disregarded zones, whether for a brief or indefinite duration.

The concept of designing for the base of the pyramid (BOP) is centered around providing sustainable and cost-effective solutions for individuals and communities with lower incomes. This approach involves a thorough understanding of their distinct requirements and obstacles, as well as the creation of tailored products, services, and systems. Collaboration with local communities and interested parties is crucial to identifying and resolving issues (Santos, Kramer; Vessoli, 2009).

The United Nations Center for Human Settlements (UNCHS - Habitat) reports a concerning trend: an ever-growing number of individuals residing at the base of the pyramid. An estimated 1.1 billion people currently live in inadequate housing conditions, and this number is expected to double by 2030. To combat this issue and provide suitable living conditions, developing countries such as Brazil require an average of 95 thousand new housing units constructed each day (Kandachar; Jongh; Diehl, 2009).

Homelessness is a constantly changing situation, which makes it hard to have precise data on this population in the country. However, recent estimates show a significant increase in the number of homeless people. From 2018 to July 2023, the number of homeless people registered in CadÚnico nearly doubled, reaching 221,113 (Brazil, 2023c). It is challenging for the government to include individuals in its planning, resource allocation, and policymaking processes when there is no official count at the national level. This lack of data makes it difficult to adequately address the needs of such individuals.

From another perspective, design for social innovation presents itself as an approach that seeks creative and innovative solutions to social and environmental problems, intending to improve people's quality of life and promote sustainability. Similar to BOP design, it entails collaboration among designers, users, and other stakeholders. The focus is on creating solutions that are accessible, inclusive, and meet people's genuine needs (Manzini, 2008).

In other words, the goal of social design is to comprehend the requirements and aspirations of individuals within a particular social environment, to devise solutions that can enhance their standard of living, and to foster beneficial transformations in society in general (Freire & Oliveira, 2017).

Considering this situation, to implement efficient public housing policies it is necessary to seek to guarantee social cohesion through actions that favor the inclusion and participation of all citizens, especially those who will use these services, in discussions and decision-making. In this way, it aims for social equity, which is the "continuous search to reduce social, cultural, economic and political barriers that result in exclusion or inequality" (Santos et al. 2019, p.49).

The purpose of this article is to examine the potential impact of the Housing First (HF) approach on housing initiatives in Brazil. Specifically, the article explores the viability of utilizing this model as a public policy solution to address the needs of individuals experiencing homelessness. This analysis aligns with the principles of sustainable design by prioritizing the social dimension and designing for the base of the socioeconomic pyramid. Ultimately, the goal is to improve the quality of life for this vulnerable population by providing safe and stable housing.



## 2. APPLICATION OF THE BASE OF THE PYRAMID (BOP) DESIGN CONCEPT TO THE HOUSING FIRST (HF) MODEL

Around 4.5 billion people are at the base of the economic pyramid, a number that corresponds to approximately two-thirds of the world's population. To develop the offer of products and services designed for the BOP, it is necessary to have a global perspective and the use of strategies aimed at meeting basic human needs. Thus, it will be possible to develop environmentally sustainable technologies and products that can be disseminated throughout the world (Prahalad; Hart, 2008).

One of the most pressing challenges of our time is to find ways to distribute products and services that enhance the quality of life of people while also being economically sustainable, culturally sensitive, and environmentally friendly. This goal demands radical innovation in various areas, including technology and

business models. As Prahalad and Hart (2008) have noted, meeting this challenge will require us to think creatively and work collaboratively to develop new solutions that benefit everyone.

Several theories define the concept of innovation, such as that found in the Oslo Manual, which establishes innovation as the "implementation of a new or significantly improved product (good or service), a process, a new marketing method or a new organizational method in business practices, workplace organization or external relations" (OECD, 2005, p. 46).

However, this definition does not cover the implications that this new product or process causes in the cultural context of a specific location. A more comprehensive definition of innovation is presented by Wijnberg (2004), as being "something new, which is presented in such a way that the value will be determined by the selectors" (Wijnberg, 2004, p. 1416).

The role of design is to comprehend the deadlock between the necessity for corporations to generate profits and the responsibility to preserve the environment. This understanding leads to a rethinking of the existing production and distribution processes. Consequently, it becomes crucial to consider the scale of the company's operations. Small-scale operations that address local issues and offer solutions that can be adapted to meet global needs should be the focus.



Encouraging the use of renewable resources and prioritizing local markets through a distributed economy network can greatly benefit communities. By viewing the population as active participants in the process, rather than just potential customers, we can foster social, economic, and environmental advantages. (Santos, Kramer; Vessoli, 2009).

The presence of high levels of poverty and social inequality in society indicates the failure of various actors to address these issues. While government bodies can regulate these issues to some extent, other organizations can also work to reduce their impact. In this context, providing businesses, products, and services to the population at the base of the pyramid presents a significant challenge (Bataglin, 2013).

This market presents itself as an opportunity for companies, government, and civil society to come together for a common cause (Prahalad; Hart, 2008). For these new contexts to become understandable, it is necessary to use innovative participatory techniques to obtain truthful information that goes beyond observational research methods carried out in common focus groups (Kandachar; Jongh; Diehl, 2009).

Thus, to create significant solutions for the BOP, a systemic approach based on evolutionary or revolutionary innovation strategies needs to be employed. These strategies should incorporate new technologies, but most importantly, should bring new meanings to users (Castillo, Diehl; Brezet, 2012).

The Housing First (HF) program is an example of a theory designed for the BOP, more specifically for people experiencing homelessness (PSR). It has characteristics such as: looking globally while proposing solutions to local problems, strategies that meet basic human needs, improving users' quality of life, and using participatory techniques. In other words, ways of including the community in the creation process and the involvement of government, companies, and society for a cause, are characterized as a likely public policy.

This theory was originally developed in the USA, but several services are being tested in other locations. Basically, HF breaks the line of "ladder services" that are widely used in Brazil to provide care for PSR. This service is characterized by immediately providing these people with safe and permanent housing before anything else, separating housing from the support services used by that community, this means that the person receives housing without having to effectively participate in other services such as psychiatric treatment or abstinence from drugs and alcohol.

> Housing First has become very influential because it is the first homelessness service that can demonstrate that it provides an enduring solution that provides housing stability for the majority of chronically homeless people. There is Strong evidence that Housing First does what no other homelessness service has managed to achieve, providing lasting solutions to the most extreme form of homelessness. (Pleace, 2012, p.41).

It has been observed that the Housing First (HF) model can be implemented to design services in various countries with different characteristics. However, despite being flexible, the model has some guidelines that need to be followed to ensure its effectiveness. The key elements that must be adhered to include providing immediate access to housing, separating housing from support services, and adopting a harm reduction approach (Pleace, 2012).

## 3. METHODOLOGICAL PROCEDURES

This article is an exploratory study that uses a qualitative approach. The methodology adopted for this study involves a literature review and data analysis to gain a deeper understanding of the topic. The study begins with bibliographical research by consulting articles, books, and other related documents to establish a theoretical basis needed to support it. This also allows for an unsystematic literature review and identification of points that need to be observed and analyzed in the following stages.

The study proceeds with the contextualization of the homeless population in Brazil and an analysis of the model proposed through the National Policy for the Homeless Population, Moradia Cidadã, which uses the concepts of Housing First. The study also investigates a specific situation that applies the concepts previously covered differently. The Tiny House Villages program in Seattle was chosen for analysis, which also uses the concepts of Housing First. This analysis was carried out based on data provided by the organization to identify contextual factors.

Finally, the study compares the data obtained, demonstrating the similarities and differences in the applicability of the Housing First concept. The advantages and disadvantages of applying the model in the social context of Brazil are also discussed.

## 4. RESULTS

The results section was organized into three topics for better understanding, they are Homeless people in Brazil (item 4.1), Housing First in Brazil – Citizen Housing Program (item 4.2), and Tiny Houses as a Housing First model (item 4.3).

### 4.1 Homeless People in Brazil

Although there is no precise data on the number of socially vulnerable people living on the streets in Brazil, the Federal Government carries out diagnoses based on data and information available in administrative records and Federal Government systems. The most recent document uses data from the Cadastro Único from December 2016 to December 2022, incorporating data provided by the Ministry of Development and Social Assistance, Family and Fight Against Hunger (MDS) until July 2023 (Brazil, 2023c).

As can be seen in Figure 1, the homeless population is on a continuous upward trend, tripling the number of people in these conditions between the years analyzed. The most significant increase was in 2022 when more than 40 thousand people were registered about the previous year. This trend justifies the establishment of public policies at the national level to help these 221,113 people registered by July 2023.

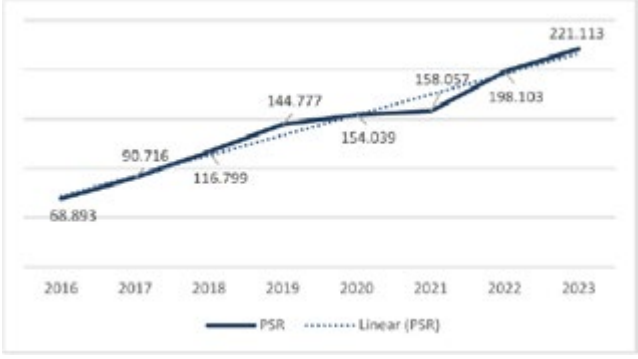


**Figure 01:** Total PSR in Brazil.
**Source:** Prepared by the author from Brazil, 2023.

In Figure 02, it can be seen that when analyzing the number of PSRs by geographic region, the Southeast region is the one with the most people in vulnerable situations, with every year analyzed a number higher than the sum recorded in the other 4 regions.

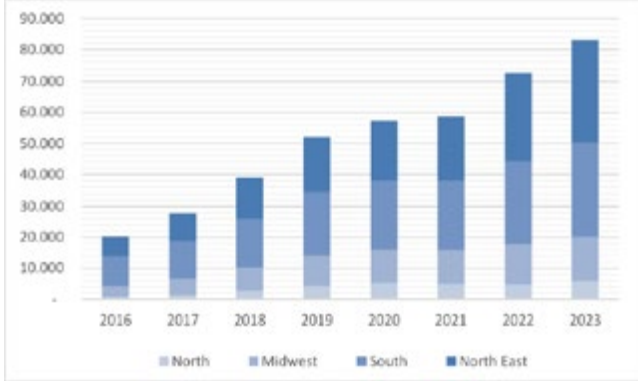


**Figure 02:** PSR in Brazil by region.
**Source:** Prepared by the author from Brazil, 2023.

The reasons why people find themselves homeless reveal a complex combination of social, economic, and personal factors. As can be seen in Figure 3, family problems are the biggest responsibility (26.64%) for this condition, highlighting the importance of family relationships in supporting conflict resolution. Unemployment (22.85%) is the second most reported reason, which indicates the fragility of networks of social security and the importance of generating employment for the economic inclusion of vulnerable groups.

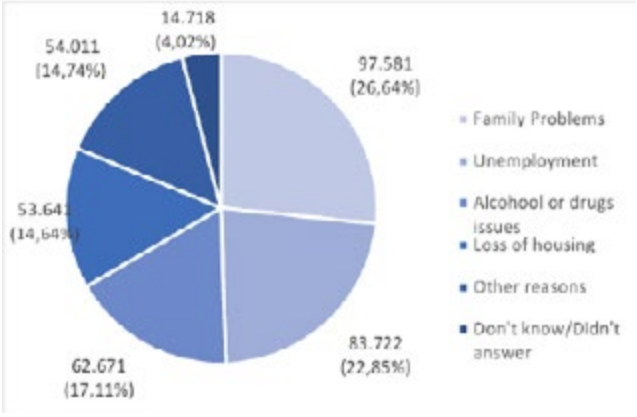


**Figure 03:** Reasons for homeless.
**Source:** Prepared by the author from Brazil, 2023.

Alcoholism and drug use (17.11%) and loss of housing (14.64%) were also cited as the main reasons for living on the streets, which highlights the challenge of drug addiction in society, the need for appropriate treatment and support approaches to deal with this problem and the provision of shelter through public policies that serve this population.

The "other reasons" category (14.74%) can include a variety of factors such as mental health issues not related to alcohol or drugs, and situations of violence or abuse, among others, demonstrating the diversity of situations that can lead to conditions on the road. Furthermore, around 4% do not know, remember, or did not answer the reason for finding themselves in this situation.

Information about where these people spend the night (Figure 4) offers an important analysis of the operating patterns of shelters and support services, such as hostels and transit centers.

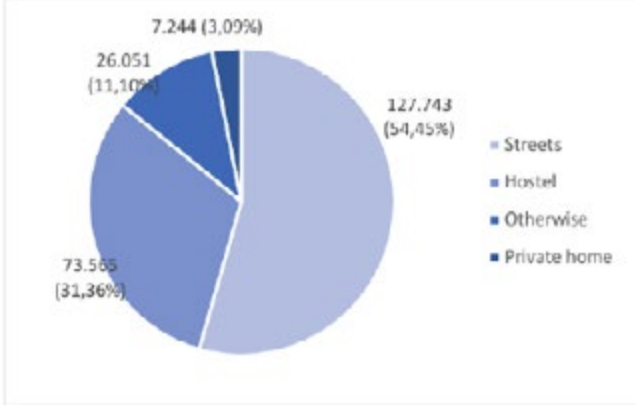


**Figure 04:** Place where they usually spend the night.
**Source:** Prepared by the author from Brazil, 2023.

The use of hostels (31.36%) indicates that people access support services and forms of temporary shelter, but in comparison with the number of people who spend the night directly on the street (54.45%) suggests the importance of expanding the availability and quality of services offered. This may be related to personal challenges related to a lack of feeling of belonging, the limited availability of shelters, or the way the services offered operate, which also make staying difficult.

It should be noted that these data do not portray the country's reality, as they only account for PSR who effectively accessed a social assistance policy and had their registration completed.

### 4.2 Housing First in Brasil– Moradia Cidadã Program

On December 23, 2009, the National Policy for the Homeless Population (PNPSR) was established through Decree No. 7,053, its objectives include "ensuring broad, simplified and safe access for the homeless population to services and programs that they integrate the various public policies developed by federal government bodies" (Brazil, 2023c, p.04).

From the PNPSR, specific services were created for this population and their inclusion in the Federal Government's Single Registry for Social Programs, facilitating access to health services even for those who do not have proof of residence (Brazil, 2023c).

In 2023, the Directorate for the Promotion of the Rights of the Homeless Population (DDPR) was created, which aims to develop plans, projects, programs, and other activities related to the implementation of the PNPSR. Na Action and Monitoring Plan was also created to act as a way of promoting and implementing the PNPSR (Brazil, 2023c).

Among the action axes of this plan, there is one aimed at housing, the intention of which is to expand the possibilities of decent housing for PSR, through prioritization of access to the Minha Casa Minha Vida Program (MCMV) and the implementation of the Housing Program Citizen.

As a way to start this project, Law No. 14,620, of July 13, 2023, which provides for the *Minha Casa, Minha Vida* (MCMV) program, cites in its Article 4 that the objectives of the program will be achieved through service lines that consider housing needs, including the Housing First project. Furthermore, in Article 8, when talking about the families that will have priority in receiving subsidized provision of housing units, there is an item about those who are homeless (Brazil, 2023a).

Having a place to call home is not only a necessity but also a crucial opportunity for people experiencing homelessness to promote autonomy and integration into society. Therefore, government policies relating to housing must consider and respond to the specific needs of these individuals. It's necessary to recognize the right to housing as a fundamental and universal human right to ensure that everyone has a roof over their heads.

Considering this notion, the Moradia Cidadã Program was established, to tackle the persistent plight of homeless individuals through an inventive and compassionate approach. Drawing on the Housing First methodology, the program recognizes that secure and sound housing is the primary and essential measure for individuals to confront other obstacles in their lives (Brasil, 2023c).

The traditional reception approach implemented in Brazil follows the steps, or "staircase" script (Figure 5), characterized initially by a social approach carried out in the POP Centers, followed by institutional reception also carried out in the POP Centers, later this user is referred to transitional housing and only then can they access permanent housing (ENAP, 2021).


**Figure 05:** Social approach models.
**Source:** Translated by the author from ENAP, 2021.

The Housing First model, used by the Moradia Cidadã Program, reverses this order, bringing access to permanent housing as the first step towards obtaining better housing life conditions. However, it still has a subsequent support system with monitoring by multidisciplinary teams and technical support, as well as connection with other public policies, security, education, and health, among others.

With pilot projects planned for three cities in 2024, the program will seek to adapt and improve the application of the methodology in the Brazilian context, with the ultimate goal of expanding its reach throughout the country (Brazil, 2023c).

Moradia Cidadã Program is based on European Housing First and follows some fundamental principles that reflect the philosophical values contained in the ideology. The quest to understand and comply with these topics guides the application and functioning of the programs, in addition to assisting so that they can be carried out effectively. According to Pleace (2016), the eight service priorities are:

- Housing is a human right;
- Choice and control for service users;
- Separation of housing and treatment;
- Recovery orientation;
- Harm reduction;
- Active engagement without coercion;
- Person-centered planning;
- Flexible Support for as long as required;

These objectives can be met in several ways, and there is not just one way to apply the Housing First model. Some programs, for example, usually work "through payment of subsidized rents in public social rental programs; local institutions have a stock of publicly owned housing units or use housing units available on the private market" (Brazil, 2019).

In other words, one way to adopt HF is through rental contracts between private owners and program organizations. The properties (apartment, house, or similar) are then subleased to participants and, from the moment these beneficiaries have an income, the program can request a percentage of their monthly income to share in expenses (Brazil, 2019).

The Moradia Cidadã program will adopt and test a solution in three planned pilot projects. This solution involves using HF to allocate homeless people almost immediately, depending on location and property availability. However, since the service is provided on an individual or family basis, it is important to deliver all properties furnished and in good housing conditions.

### 4.3 Tiny Houses as a Housing First Model

Regardless of the way housing is offered, the most important thing for Housing First is the reversal of the order of this event, no longer being the last step in the process, and yes, the first step towards the reintegration of PSR into society. As an example of another way of using this model, we can mention the actions used by the Low Income Housing Institute (LIHI).

LIHI is located in the city of Seattle and is committed

to defending low-income and homeless people. Its work began with offering defense and technical assistance services to promote the interests of this population and is currently working on offering transitional and permanent housing, using HF concepts.

Among its works, we can mention the renovation of abandoned buildings to implement low-income housing units, self-management of these buildings, and development of innovative housing solutions. By using creative projects and sustainable design features, the Institute can offer affordable housing for low-income and homeless people. It also works to defend fair public policies at the local and national level, seeks to assist in self-sufficiency, and promotes housing stability to form a strong and committed community.

In addition to providing housing, they manage the so-called Urban Rest Stops, hygiene centers that offer bathing and laundry services in a clean, safe, and dignified environment, as well as the distribution of hygiene items, all free of charge to people in street situations.

The LIHI organization offers various services, but the Tiny House Villages program is particularly noteworthy for this research as it employs the Housing First philosophy. Initially, the program started as a tent camp to provide shelter for homeless individuals at LIHI's headquarters. However, to improve the quality of service, the program evolved to include wooden shelters (Figure 6), making it a model program for cities that seek more effective and sustainable solutions to support individuals experiencing social vulnerability.



**Figure 06:** Tiny House Villages .
**Source:** LIHI, 2023.

Currently, the institute has 18 villages that are operated or supported by them, with the capacity to serve more than 2000 people annually. Each house is approximately 8' x 12' (8.82m$^2$) and the materials for its construction cost around US$4,500, equivalent to approximately R$22,000.00. All of them have structures to keep residents in safe conditions, with electricity, insulation, and heaters.

Each village has hygiene, laundry, and communal kitchen facilities, which contribute to reducing production and maintenance costs. In addition, they have access to public services and a supportive neighboring community that is committed to the success of the program and its residents. LIHI has a partnership program with neighbors, volunteers, community groups, NGOs, religious organizations, companies, clubs, and schools that help support residents with donations and meals.

The success of the project hinges on a robust network of collaborators that fosters community involvement and a sense of belonging among future residents in their new social context. The institute's data indicates that support and housing services have been instrumental in removing individuals from the streets, with 65% of participants securing employment and permanent housing within six months of joining the program, as shown in Figure 7.

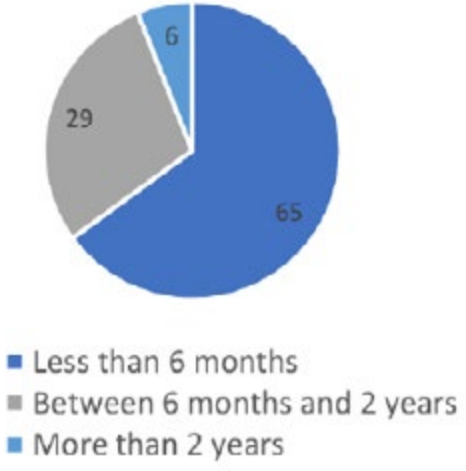


**Figure 07:** Tiny House Villages .
**Source:** LIHI, 2023.

One of the interesting points of this project is that LIHI works with open-source design, having a complete database with files that help in the implementation of Tiny Houses Villages by anyone, anywhere in the world.

The data shares information from various models, such as safety guidelines, forms, a list of materials, tools and equipment needed for construction, photos of all assembly stages, and a complete guide with all the steps for building a Tiny House (Figure 8).


**Figure 08:** Page 48 of Tiny House Construction Manual.
**Source:** LIHI, 2023.

The program in question provides communities with the flexibility to tailor the project to their specific needs. This means that any modifications can be made to the program, ensuring that it is more effective and relevant to the local community. By doing so, the program can be implemented safely and efficiently, resulting in positive outcomes. The ability to modify the program allows for a more targeted approach, which can help to address specific concerns and issues within the community. Overall, this flexibility ensures that the program is better suited to the unique needs of each community it serves.

## 5. FINAL CONSIDERATIONS

To implement Housing First (HF) in Brazil, it is necessary to adapt this model to the country's local conditions, such as verifying the structuring of support services and considering cultural and socioeconomic diversities. Design, in this context, plays an important role in adapting HF guidelines into tangible and effective solutions, but the process also involves other agents such as architects, social workers, health professionals, and members of local communities to ensure the necessary support, reaffirming the interdisciplinary character of a project of these dimensions.

However, other forms of application can be considered in addition to subsidized rent, so that it is possible to determine which one best adapts to the Brazilian context. An alternative would be the implementation of projects based on Tiny House Villages, which offer minimum conditions for rest, food, and hygiene, in addition to introducing a sense of responsibility for the property, which will be used until its cycle of integration into society is completed.

One of the differences between these approaches is related to the way housing is provided. While in subsidized rent, beneficiaries have access to conventional apartments or houses, Tiny Houses offer smaller, simplified spaces.

Community integration is a crucial factor to contemplate when deciding on a living arrangement. Traditional neighborhoods may offer positive or negative interactions with the local community depending on the location. However, Tiny House Villages are thoughtfully planned and situated within communities that are dedicated to the cause, fostering a strong sense of belonging among residents.

When considering expenses, it's important to note that while subsidized rent may seem cheaper initially, in the long run, it can result in higher costs due to the project's potential expansion on a larger scale. Additionally, challenges related to the availability of subsidized housing and the rising real estate market costs should be taken into account. Alternatively, Tiny Houses may have a higher initial cost, but their long-term maintenance expenses tend to be lower, and they can be constructed in greater quantities over a shorter period of time compared to traditional masonry construction.

Regarding the potential for promoting sustainability, Tiny Houses stands out with the choice of materials with low productive impact, the incorporation of renewable energy systems, the optimization of ventilation and natural lighting, and the reuse of structures by new residents as soon as they are installed. houses are unoccupied. As for subsidized rent, although there is no direct construction of a product, but rather the rental of people in existing homes, its costs are never fixed and are dependent on the real estate market.

In short, both approaches represent innovative solutions to homelessness found in BOP, having their advantages and disadvantages. The choice between these approaches must consider the specific needs of the community, the available resources, and the preferences of the beneficiaries, the latter being of great importance for the decision-making process and acceptance of the

chosen solution.

It can be seen that, regardless of the way housing is offered, the most important thing for Housing First is the reversal of the order of this event, no longer being the last stage of the process, but the first step towards the reintegration of PSR into society.

BOP design can be a source of local transformation, but it also seeks global sustainability in terms of production and consumption. In this way, being complex makes the development of products and services for an audience made up of billions of people with limited access to basic elements such as health, food, basic sanitation, and shelter, among others.

Accessibility, both physical and economic, and sustainability are also critical aspects of the program. Therefore, it is crucial to consider the complete life cycle of products and systems, the construction techniques used, and the environmental and social impacts over time. Design solutions seek to resolve the specific challenges faced by populations in vulnerable situations, which is why a user-centered approach that involves potential residents in the process is of great importance.

The program must be flexible and adaptable, acknowledging that solutions can vary depending on deployment region.



Adapting Housing First (HF) to the Brazilian context presents both challenges and opportunities. However, it must be done with sensitivity, empathy and based on technical knowledge. Sustainable design for the Bottom of the Pyramid (BOP) is crucial in integrating the concept of decent housing with the responsibility to promote equity. By achieving this feat, a project using Housing First in Brazil can become a prime example of promoting positive changes in society, fairly and innovatively.

## REFERÊNCIAS

BATAGLIN, Jaiarys. **Inovação Sustentável e a Base da Pirâmide (BOP):** Um Estudo de Caso na Unilever. XVI ENGEMA - Inovação e sustentabilidade: um desafio para enfrentar as mudanças climáticas e seus impactos planetários. Encontro Internacional sobre Gestão Empresarial e Meio Ambiente-ENGEMA, São Paulo, 2014, v. 6. Disponível em: https://engema.submissao.com.br/16/resultado/an_resumo.asp?cod_trabalho=346 Acesso em: 25 ago. 2023

BRAZIL, Ministério do Desenvolvimento Social e Combate à Fome. **Rua: aprendendo a contar: Pesquisa Nacional sobre a População em Situação de Rua.** Brasília, DF: MDS; Secretaria de Avaliação e Gestão da Informação, Secretaria Nacional de Assistência Social, 2009. Disponível em: https://fpabramo.org.br/acervosocial/estante/rua-aprendendo-contar-pesquisa-nacional-sobre-populacao-em-situacao-de-rua/ Acesso em: 25 jul. 2023.

BRAZIL. Ministério da Mulher, da Família e dos Direitos Humanos. **É possível Housing First no Brasil?:** experiências de moradia para população em situação de rua na Europa e no Brasil. Brasília, DF: MMFDH, 2019. Disponível em: https://www.gov.br/mdh/pt-br/navegue-por-temas/populacao-em-situacao-de-rua/DHUM0117_21x26cm_WEB4Pg.Separadas.pdf Acesso em: 19 dez. 2023.

BRAZIL. **Lei nº 14.620,** de 13 de julho de 2023a. Dispõe sobre o Programa Minha casa, Minha Vida. Disponível em: https://www.planalto.gov.br/ccivil_03/_ato2023-2026/2023/lei/l14620.htm. Acesso em: 07 nov. 2023.

BRAZIL. Ministério dos Direitos Humanos e da Cidadania. **População em Situação de Rua:** diagnóstico com base nos dados e informações disponíveis em registros administrativos e sistemas do Governo Federal. Brasília, DF: MDHC, Secretaria Nacional de Promoção e Defesa dos Direitos Humanos, 2023b. Disponível em: https://www.gov.br/mdh/pt-br/navegue-por-temas/populacao-em-situacao-de-rua/publicacoes/relat_pop_rua_digital.pdf Acesso em: 25 nov. 2023.

BRAZIL. Ministério dos Direitos Humanos e da Cidadania. **Plano nacional Ruas Visíveis**. Brasília, DF: MDHC, 2023c. Disponível em: https://www.gov.br/mdh/pt-br/assuntos/noticias/2023/dezembro/governo-federal-lanca-201cplano-ruas-visiveis-pelo-direito-ao-futuro-da-populacao-em-situacao-de-rua201d-com-investimento-de-cerca-de-r-1-bilhao/copy2_of_V3_plano_acoes_populacao_de_rua1.pdf Acesso em: 15 nov. 2023.

CASTILLO, L.; DIEHL, J. C. BREZET, H. **Design Considerations for Base of the Pyramid (BoP)**

**Projects.** Cumulus 2012 Conference, Helsinki, 2012. Disponível em: https://www.researchgate.net/publication/257927083_Design_Considerations_for_Base_of_the_Pyramid_BoP_Projects. Acesso em: 22 jul. 2023.

ENAP – Escola Nacional de Administração Pública. **Modelo Moradia Primeiro (Housing First) para a População em Situação de Rua – Módulo 1.** Pasta Pública. Brasília: ENAP, 2021.

FREIRE, K. de M.; OLIVEIRA, C. M. M.. Comunidades criativas e codesign. In: ARRUDA, A. J. V. (org.). **Design e inovação social.** São Paulo: Blucher, 2017. p. 109-132.

IPEA, Instituto de Pesquisa Econômica Aplicada. **Estimativa da população em situação de rua no Brasil (setembro de 2012 a março de 2020).** Brasília: Ipea, 2020. (Nota Técnica, n. 73) Disponível em: http://repositorio.ipea.gov.br/handle/11058/10074. Acesso em: 12 ago. 2023.

KANDACHAR, P.; DE JONGH, I.; DIEHL, J. C. (ed.). **Designing for Emerging Markets:** Design of Products and Services. Delf: Delf University of Technology, 2009. Disponível em: https://www.researchgate.net/publication/257926843_Designing_with_Emerging_Markets_Design_of_Products_and_Services Acesso em: 14 ago. 2023.

LIHI. **Low Income House Institute**, c2023. Homepage. Disponível em: http://www.lihihousing.org/. Acesso em: 14 de ago. de 2023.

MANZINI, E. **Design para a inovação social e sustentabilidade:** Comunidades criativas, organizações colaborativas e novas redes projetuais. Rio de Janeiro: E-papers, 2008.

OECD. Organisation For Economic Co-Operation and Development Statistical Office of the European Communities. **Guidelines for Collecting and Interpreting Innovation Data.** Oslo Manual. 3. ed. Paris: OECD Publishing, 2005. Disponível em: https://www.oecd-ilibrary.org/science-and-technology/oslo-manual_9789264013100-en Acesso em: 10 ago. 2023.

PLEACE, N. **Housing first:** European Observatory oh Homelessness. França, DIHAL, 2012. Disponível em: https://www.feantsaresearch.org/download/housing_first_pleace3790695452176551843.pdf. Acesso em: 22 jul. 2023.

PLEACE, N. **Housing first guide Europe: Research report.** Brussels: FEANTSA, 2016. Disponível em: https://www.feantsa.org/download/hfg_full_digital1907983494259831639.pdf Acesso em: 05 nov. 2023.

PRAHALAD, C. K.; HART, S. L. The Fortune at the Bottom of the Pyramid. E**stratégia & Negócios,** Florianópolis, v.1, n. 2, jul./dez.2008. Disponível em: https://www.researchgate.net/publication/260943834_The_Fortune_at_the_Bottom_of_the_Pyramid. Acesso em: 15 jul. 2023.

SANTOS, A. et al. **Design e Sustentabilidade:** Dimensão Social. 1. ed. Curitiba: Insight, 2019.

SANTOS, A.; KRÄMER, A.; VEZZOLI, C.. Design brings innovation to the Base of the Pyramid. **Design Management Review,** v. 20, n. 2, p. 78-85, out., 2009. Disponível em: https://www.researchgate.net/publication/230375861_Design_Brings_Innovation_to_the_Base_of_the_Pyramid. Acesso em: 15 jul. 2023.

WIJNBERG, N. M. Innovation and Organization: Value and Competition in Selection Systems. **Organization Studies**, 25(8), p. (1413-1433), out., 2004. Disponível em: https://www.researchgate.net/publication/240279694_Innovation_and_Organization_Value_and_Competition_in_Selection_Systems. Acesso em: 12 ago. 2023.

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# PROPOSAL TO REDUCE ENVIRONMENTAL IMPACT THROUGH PACKAGING SYSTEM DESIGN

## *DESIGN DE SISTEMA DE EMBALAGEM PARA A REDUÇÃO DE IMPACTOS AMBIENTAIS*

## *DISEÑO DE SISTEMA DE EMBALAJE PARA LA REDUCCIÓN DE IMPACTOS AMBIENTALES*

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**ABSTRACT**

One of the necessary steps for Packaging-Oriented Systems Design deals with mapping all packaging and accessories along a given value chain. This mapping covers the main filling, storage, and distribution flow, as well as its relationship with packaging levels and parallel flows, incorporated from other stages of the life cycle. These relationships can waste resources and cause environmental impact if they are not visible during the process. The objective of this article is to propose a framework to make the flow of artifacts throughout a Packaging System visible, with a view to reducing environmental impact. The framework was tested and evaluated in a dairy industry, resulting in a possible 20% reduction in packaging used to contain the same volume of product, if the improvements proposed from the study were applied. The method used was Design Science Research. The study contributes to advancing the understanding of the operationalization of Systems Design in the context of packaging, presenting the complexity of the relationship between the packaging and the product during its life cycle and its interactions with the companies' internal and external processes.

**KEYWORDS**

Systems Design; Environmental impact; Sustainability; Packaging system.

***RESUMO***

*Uma das etapas necessárias para o Design de Sistemas Orientados para Embalagens lida com o mapeamento de todas as embalagens e acessórios ao longo de uma determinada cadeia de valor. Esse mapeamento abrange o principal fluxo de distribuição, armazenamento e distribuição, bem como sua relação com os níveis de embalagem e fluxos paralelos, incorporados de outras etapas do ciclo de vida. Essas relações podem desperdiçar recursos e causar impacto ambiental se não forem visíveis durante o processo. O objetivo deste artigo é propor uma estrutura para tornar visível o fluxo de artefatos ao longo de um Sistema de Embalagem, com vistas à redução do impacto ambiental. A estrutura foi testada e avaliada em uma indústria de laticínios, resultando em uma possível redução de 20% nas embalagens usadas para conter o mesmo volume de produto, caso as melhorias propostas a partir do estudo fossem aplicadas. O método utilizado foi Design Science Research. O estudo contribui para o avanço da compreensão da operacionalização do Design de Sistemas no contexto das embalagens, apresentando a complexidade da relação entre a embalagem e o produto durante seu ciclo de vida e suas interações com os processos internos e externos das empresas.*



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***PALAVRAS-CHAVE***

*Design de Sistemas; Impacto ambiental; Sustentabilidade; Sistema de embalagem.*

***RESUMEN***

*Uno de los pasos necesarios para el Diseño de Sistemas Orientados a Embalajes trata del mapeo de todos los embalajes y accesorios a lo largo de una cadena de valor determinada. Este mapeo cubre el flujo principal de llenado, almacenamiento y distribución, así como su relación con los niveles de embalaje y flujos paralelos, incorporados desde otras etapas del ciclo de vida. Estas relaciones pueden desperdiciar recursos y causar impacto ambiental si no son visibles durante el proceso. El objetivo de este artículo es proponer un marco para hacer visible el flujo de artefactos a lo largo de un Sistema de Embalaje, con miras a reducir el impacto ambiental. El marco fue probado y evaluado en una industria láctea, resultando en una posible reducción del 20% en los embalajes utilizados para contener el mismo volumen de producto, si se aplicaran las mejoras propuestas a partir del estudio. El método utilizado fue Design Science Research. El estudio contribuye a avanzar en la comprensión de la operacionalización del Diseño de Sistemas en el contexto de los embalajes, presentando la complejidad de la relación entre el embalaje y el producto durante su ciclo de vida y sus interacciones con los procesos internos y externos de las empresas.*

***PALABRAS CLAVE***

*Diseño de Sistemas; Impacto ambiental; Sostenibilidad; Sistema de embalaje.*

## 1. INTRODUCTION

Packaging throughout its history has represented an important tool for the commercial development and growth of cities, as it ensures that the product reaches the end consumer in safe and quality conditions. It is the result of the action of a complex and multidisciplinary system, made up of the actions of several specialists who develop complementary activities, such as researchers, designers, operators, among others involved in its conception (ROBERTSON, 2013; SASTRE et al., 2019).

A company's Packaging System (PS) is conventionally understood as a set of processes, materials and technologies used to package, protect, distribute, and market the products that the company manufactures or sells (CABRAL; CABRAL, 2010). From this perspective, when well designed and adapted through the integrated process of packaging, product and logistics development, opportunities are achieved to save resources, reduce environmental and commercial costs, and increase efficiency throughout the chain (MOLINA-BESCH; PÅLSSON, 2014). The PS can be understood as composed of several intertwined flows (MUNIZ; POSSAMAI, 2019), being designed to serve many contexts that interact in a complex way (BARABASI, 2005). Design decisions regarding the type of material and format, for example, can impact the primary function of packaging, affecting the stages of production, distribution, commercial actions, use and disposal by consumers and, ultimately, causing damage to the environment.

Designing packaging-oriented systems involves considering aspects such as the profile of the actors required in the system, as well as the configuration and dynamics of process and operations flows, in addition to the portfolio of packaging and associated services. From the perspective of the Production Function Mechanism, proposed by shingo (1989) the analysis of flows within a packaging-oriented system needs to start with the "process", that is, with the flow of materials and/or information. Analysis of the flow of operations (people or machines) must be carried out after analyzing the process.

Due to the significant representation of packaging as a source of waste generation on the planet, company managers are seeking to outline strategies to prevent and, when this is not possible, reduce its demand. Such efforts require an accurate analysis of the points of presence of waste and environmental impacts during the process. In this way, the application of the contemporary perspective of sustainability demands that the ES contemplates the social, economic, and environmental dimensions concomitantly. In this sense, it is considered that developing an ES with superior environmental performance cannot necessarily be considered sustainable (DE KOEIJER; DE LANGE; WEVER, 2017). It is observed that the search for improving the environmental performance of packaging often emphasizes the use of non-toxic, renewable, local, and recyclable materials. The selection of these materials and respective processes requires carrying out life cycle assessments (LCA) that support the decision process to minimize the ecological footprint.

From an economic perspective, a PS contemplates not only issues of a financial nature, including criteria such as equity between actors, encouraging local entrepreneurship, prioritizing network organizations, sharing local assets, among other aspects. From a social perspective, the PS needs to consider mechanisms for integrating the weak and marginalized, respect for local culture, the promotion of social cohesion, equipping consumers to make socially fair and ethical choices (ABDUL KHALIL et al., 2016; BESIER, 2015; PETLJAK; NALETINA; BILOGREVIĆ, 2019).

That said, the skills required of professionals working in the packaging sector transcend the limits of packaging itself. With the purpose of contributing to a better understanding of these skills, this research proposes to answer the following question: how to identify losses related to packaging in the production system with the aim of identifying opportunities for improvement and reduction of environmental impact? The objective of this article is to propose a framework to make companies' packaging systems visible with a focus on reducing environmental impact.



## 2. PACKAGING-ORIENTED SYSTEMS DESIGN

This section describes the theoretical references relating to the construction of the proposed framework, based on the vision of integration between the packaging and product life cycle, as well as the packaging classification and the definition of the Packaging System.

### 2.1 Integration between the packaging and product life cycle

The starting point of the life cycle is the extraction of raw materials from nature and their subsequent transformation for use in packaging. The third stage deals with the

design phase: the logical and creative conception of the packaging (structural and graphic) carried out by a studio, design agency or internal project team within the company, which will subsequently forward it to the packaging industry. In some cases, the packaging industry itself adapts the design to available matrices. Next, the packaging manufacturing phase. It can be said that the continuity of the packaging life cycle overlaps with the life cycle of the product for which the packaging was designed, and this overlap occurs from the filling phase onwards (Figure 1). The sales/distribution phases can occur in different ways, whether on a supermarket shelf or e-commerce, for example. The use phase is when the consumer meets the packaging. Finally, the packaging is discarded, treated, and sorted. When previously viewed by the designer from a systemic perspective, the life cycle phases generate the opportunity for action to close the cycle in a sustainable way. In this case, the packaging may be returned to the factories and recycled or another procedure that extends its useful life (reuse, remanufacturing) (JANG et al., 2020). There is also the possibility of returning the packaging to the natural system, when it is compostable (CASAREJOS et al., 2018).

It is important to highlight that packaging has its own life cycle, whether primary, secondary or others. Even though they are an integral part of a product (product--packaging system), the cycles of both run in parallel until they overlap after packaging and may separate again after the product is used (Figure 1). When a product reaches the end of its useful life, it must be separated from its packaging so that appropriate treatments can be given to both. Post-use or end-of-life costs are also related to reverse logistics for treatment and final disposal purposes.



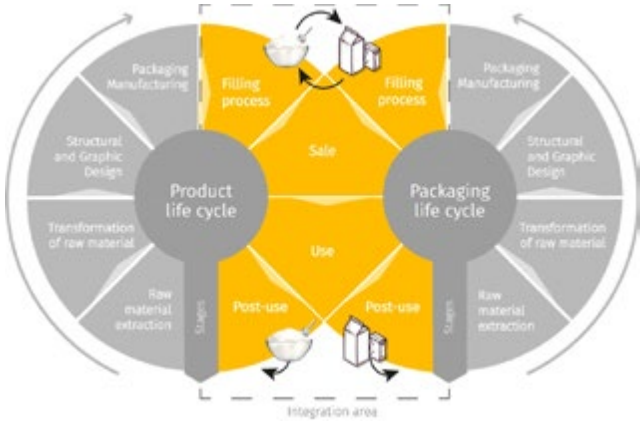


**Figure 1:** Overlap between packaging and product life cycles.
**Source:** by the authors.

In the view of the authors of the present study, the Packaging System is located exactly in this overlap between the life cycle of the product and the packaging, requiring extensive knowledge of the technical characteristics and limitations of the production lines and equipment involved, as well as the processing processes. distribution, sale, use and post-use of products and their packaging.

Although physically the superposition generally occurs from the filling phase (Figure 1), from the first phase (definition of the packaging raw material), it is necessary to evaluate the nature of the product's raw material, for the purposes of evaluating compatibility between packaging material and product material that will be sent to the filling process. This is essentially relevant when the material being filled is in a liquid or semi-solid physical state, as the chances of chemical interactions between the packaging wall and the filled material are more likely (SZCZEPAŃSKA; KUDŁAK; NAMIEŚNIK, 2018).

Molina-Besch e Pålsson (2014) suggest that companies along the supply chain must align their objectives and integrate resources related to packaging so that it provides maximum value to all actors in the supply chain. A prerequisite for sustainable supply chains is that companies systematically consider relevant logistical aspects during the packaging development process. The authors Molina-Besch and Pålsson (2014) list 4 integrative elements of packaging development processes as relevant to the sustainability of supply chains:

- **Integration with product development -** because product and packaging are transported, stored, and handled together in many parts of the supply chain, an integrated product and packaging development process is required.

- **Integrated development of packaging system levels -** the different levels of a PS can be developed successively from one end or in an integrated approach, in search of system optimization.

- **Cross-process functionality -** if PS are to be adapted to different requirements along the supply chain, the packaging requirements of different actors must be considered systemically.

- **Involvement of external supply chain actors -** to consider the external aspects of the company's supply chain, external supply chain actors must be consulted and involved in the packaging development process.

Decisions related to packaging development (size, material, format, etc.) and their interactions throughout the entire life cycle (product protection, consumption method, disposal method, etc.) can minimize the environmental impacts of the packaging. packaging-product system and promote a Circular Economy when the project includes appropriate materials and processes, ensuring the desired protection for the product, without excessive consumption of material and with the revaluation of post-consumer material (ABRE, 2016).

## 2.2 Packaging classification

Packaging in general can be classified as primary, secondary, and tertiary (BRISSON, 1993; CARVALHO, 2008; MAHMOUDI; PARVIZIOMRAN, 2020a). The primary ones are those used by the industry when packaging the product (lid, bottle, and label). Secondary packaging is consumer packaging, those that are in contact with the user and displayed at the point of sale. Transport packaging is tertiary and contains all the previous elements in an organized manner (CARVALHO, 2008; HELLSTRÖM; NILSSON, 2011; MAHMOUDI; PARVIZIOMRAN, 2020b; MOURA; BANZATO, 1997). According to Hellström and Nilsson (2011), this classification is used when considering packaging as a system and illustrates the packaging components and hierarchy levels (Figure 2).


**Figure 2:** Packaging classification
**Source:** by the authors.

For reasons of safety and maintaining the integrity of the product, some components are used, such as angles and plastic films for pallets, or even a cradle can be adopted inside the consumer packaging to ensure that the bottle will not suffer any damage during transportation breakdown, for example. In some cases, transport packaging serves as consumer packaging. This occurs in larger products, such as household appliances and machines. Expanding this classification, we present fourth-level packaging, which facilitates movement and storage in transport, and fifth-level packaging, used for long-distance shipments, such as containers (MOURA; BANZATO, 1997). Each level of importance and the functions that packaging fulfills in packaging products will determine the type of solution to be adopted.

From a sustainability point of view, it is understood that good projects must replace or minimize the profusion of packaging levels throughout logistical processes, since their useful life is usually short and they are not always produced in a sustainable way (MAHMOUDI; PARVIZIOMRAN, 2020b). It also affects environmental performance in terms of waste handling and filling rates in transport. Therefore, in a Packaging System with different levels, the functions must be seen from the perspective of the system. This means that it is the entire system that must, for example, protect the product. Thus, enhanced protection of secondary packaging can reduce the level of protection required in primary packaging and vice versa, depending on the context (PÅLSSON; HELLSTRÖM, 2016). Therefore, the reuse of secondary, tertiary and higher levels of packaging is advocated, from a perspective of circularity and extension of useful life (SELVIARIDIS et al, 2016).

## 2.3 Packaging System

The Design of a Packaging-oriented System deals with the configuration of the actors and the dynamics of the respective flows (materials, information capital, services). The conventional perspective is more restricted regarding PS, considering only the set of processes, materials and technologies used to package, protect, distribute, and sell the products that the company manufactures or sells (CABRAL; CABRAL, 2010). For Moura and Banzato (1997), a Packaging System is an interrelated set of operations and materials necessary to move products from the point of origin to the point of consumption, including machinery, equipment, and vehicles for their shipment (MOURA; BANZATO, 1997). The authors also define that, as in all systems, the parts are numerous and diverse, and all "decisions made and implemented at the level of one component cause ramifications at other levels" (MOURA; BANZATO, 1997).

When the material and information flows of an PS are designed appropriately, the elimination or mitigation of environmental impacts, equity and social cohesion, in addition to equity and economic justice are achieved. From an operational perspective, the industry can save resources by reducing materials, optimizing space, reducing

damage and losses, distributing efficiency, and incorporating sustainable practices. At the highest level, the system can include strategies that result in the prevention of the use of packaging, such as the digitalization of products, the servitization of consumer relations, the encouragement of the sharing economy, as well as social and lifestyle innovations that can completely suppress the demand for packaging. In this sense, in cases where strategies aimed at preventing consumption are more restricted, it is possible to integrate logistical and supply chain considerations into the packaging development process, seeking to minimize and optimize resources, bringing not only economic benefits to companies, but also opportunities to reduce environmental and commercial costs and increase efficiency throughout the chain (MOLINA-BESCH; PÅLSSON, 2014).

However, Palsson et al. (2013) shows that current models and methods used to support packaging selection in manufacturing companies rarely consider sustainability dimensions. Furthermore, they often do not reflect the entire supply chain, as assembly and material supply systems are largely designed separately, which leads to sub-optimization. To avoid it and facilitate an integrative approach to assembly and material supply systems, packaging can play a key role, as there are several interactions between packaging and logistics along the supply chain. Molina-Besch and Palsson (2014) consider that packaging is a central component in logistics, as it adds weight and space to products during handling and transport, but also facilitates the use of volume due to the stacking capacity and efficiency of packaging. handling. At workstations relevant to the assembly of packaging and insertion of products to be transported/protected, it is possible to obtain considerable time and cost savings by adjusting the packaging system to the assembly situation in question and the components used (PÅLSSON; FINNSGÅRD; WÄNSTRÖM, 2013). In this way, packaging has a direct impact on the energy use of transport, handling, and storage processes, in addition to influencing the amount of product waste throughout supply chains (MOLINA-BESCH; PÅLSSON, 2014). Furthermore, it has other functions of great importance, such as being a potential driver of consumer education and reinforcing people's connection to the culture of a territory.

In short, a Packaging System (PS) encompasses all aspects related to packaging in its life cycle, from the selection of raw materials to the design, distribution, and post-use processes. Decisions and assessments involving packaging require a holistic approach that considers all parts of the supply chain. Packaging must be understood as a complex system that encompasses predictable and/or unexpected interactions between its parts and processes, therefore requiring permanent attention to the whole and each of its parts throughout its life cycle, to can be managed efficiently and effectively (CABRAL; CABRAL, 2010; SASTRE et al., 2019).

## 3. RESEARCH METHOD

Aiming to develop an instrument to make companies packaging systems visible with a focus on reducing environmental impact, three stages of the Design Science Research methodology based on Dresch were used; Lacerda; Cauchick (2019). Design Science is the science that seeks to consolidate knowledge about the design and development of solutions to improve existing systems, solve problems and create artifacts DRESCH; LACERDA; JUNIOR, 2015). Implementation is part of a development cycle that must be tested and converge to a result at each stage, until reaching final verification, through validation of the artifact's usefulness. The procedure developed in the three stages shown in Figure 3.

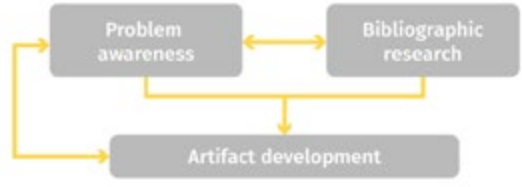


**Figure 3:** DSR steps adopted.
**Source:** by the authors.

### 3.1 Problem awareness

At this stage, consultation began with literature reference bases and the construction of knowledge related to the integration between the packaging and product life cycle, the definition of PS and in which context it is inserted, as well as problems, waste and impacts caused by packaging in its chain. Preliminary searches were carried out in books and articles randomly and search string tests were carried out for the literature review. After the preliminary search, articles, and books relevant to the topic were grouped in Mendeley (reference management software), read, and analyzed by the authors. The authors visited two companies and carried out a preliminary mapping of their Packaging Systems to verify their performance in

practice. Raising awareness of the problem initially had the purpose of surveying the topic in the literature and within companies.

### 3.2 Bibliographic research

This stage required a bibliographical review, with emphasis on books, magazines, standards, theses, and dissertations, as well as technical materials available on the internet. The chosen string was composed of the keywords and Boolean operators "Packaging and supply chain integration and Sustain*". The research base was the Web of Science. The search resulted in 66 articles on the topic, of which 22 articles were selected for full reading. During the systematic literature review, other articles referenced in the text were extracted (unsystematic literature review) and incorporated into the reference base of the present study.

The purpose of the literature review was to identify theoretical content that the designer needs to access to develop a PS that meets design requirements, reduces environmental impact, and meets the needs of stakeholders. This review was necessary to organize the theoretical framework to compose the proposed framework. The content of the reference model was structured based on context units and analysis units. The context units were those related to the conditions or phases of the life cycle in which the packaging may be inserted. Units of analysis refer to guiding elements that can be applied to context units.

### 3.3 Artifact development

For the development of the artifact, relevant contents were defined to compose the graphical representation of the framework and based on these, the functions it should fulfill. The contextual structure defined for the framework was supported by the integrated phases of the packaging and product life cycle, organized according to the logic of the circular economy. It should be noted that the visual model was developed based on the packaging, sale, use and post-use process phases. Following an abductive logic, the elements contained in the framework were designed using information extracted from the literature.

The artifact was evaluated by the authors and 2 experts (product designer specializing in packaging projects and doctor in production engineering specializing in sustainable product design). A 3-hour meeting was held with the 2 experts, the debate was recorded, transcribed, and later analyzed.

The framework was tested in one company a manufacturer in the dairy sector. To this end, the product manufacturing, packaging, storage, distribution, and sale processes were observed and mapped. At the same time, interviews were carried out with managers and operators from all sectors related to the processes. In the end, PS maps and reports with opportunities for improvement were generated, which were discussed and validated with company managers. The experts reflected on the particularities of the cases and their influence on the framework, searching for patterns that serve the different cases.

## 4. RESULTS AND ANALYSIS

Figure 4 presents the proposed framework to make companies Packaging System visible. The model helps to facilitate the identification of opportunities for improvements in PS with a focus on reducing environmental impact through the analysis of losses in the company that manufactures a given product. The objective of this framework is to make visible the generation and disposal of process packaging waste, product components and inputs, from product manufacturing to distribution, transportation, sales, use and disposal at the end of its useful life, both in processes internal and external to the company.

The internal processes, in gray, begin with the manufacturing of the product and end in the quaternary packaging, where distribution begins. Processes external to the company, in brown, continue until the post-use stage. The result of the framework can be seen in figure 4, and the detailed description of each part that makes it up can be understood below. In figure 5, a schematic representation of the framework can be seen, highlighting the convergent PS that start outside the company's flow (starting from the production flows of input and packaging suppliers) and end up generating waste that becomes the company's responsibility.

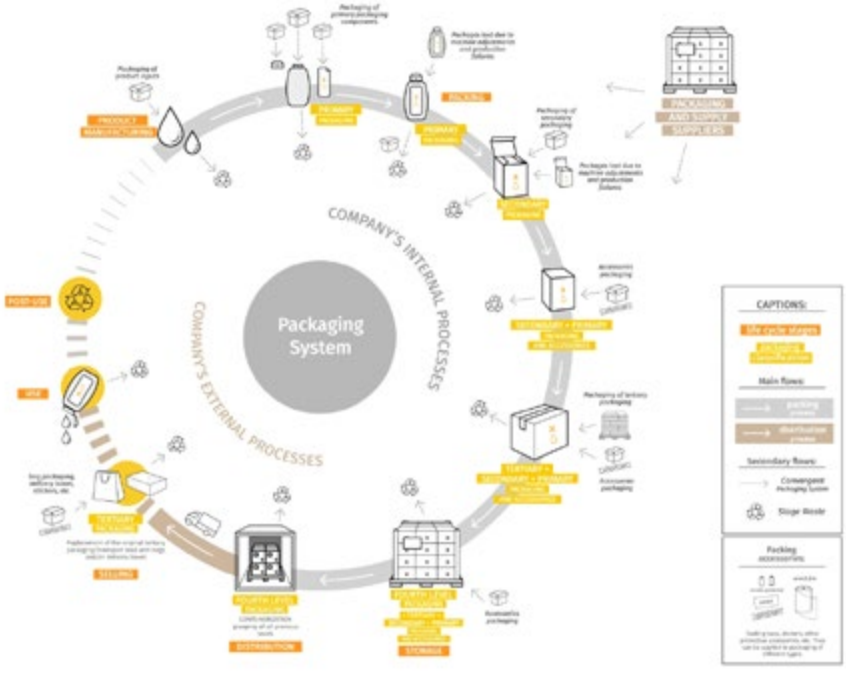


**Figure 4:** Packaging System Framework.
**Source:** by the authors.

The elements contained in this graphic representation are essential for understanding the possible waste and environmental impacts caused during the product manufacturing and distribution process.

- **Internal and external processes:** Internal processes, represented in gray, refer to the operations and sectors directly involved with packaging, where the company has greater autonomy in the case of decision-making, such as the internal production, planning and control sectors production (CSP), environmental engineering, inventory, shipping, quality, purchasing, commercial, among others. External processes, represented in brown, are interactions in the life cycle in which the industry has less autonomy in decision-making, as well as less process traceability, such as packaging and input suppliers, distributors, transport companies, points of sale, end consumers, sorting cooperatives, among others. The brown color is represented in solid color until sale, where it takes on a spaced format that becomes increasingly dispersed as it approaches post-use, to demonstrate that the company normally loses control and tracking over these stages.

- **Packaging and product life cycle:** The life cycle stages, in orange, are important to obtain an overview of the process and at the same time meet the design and production demands in each of them. The flow representation in gray shows the product filling and storage processes and, in light brown, the distribution, sale, use and post-use processes.

- **Packaging classification:** The types of packaging and components (in yellow) used throughout the process must be mapped in their entirety to make it possible to analyze the usefulness of each part, as well as proposed replacement or elimination of packaging levels and/or or components used, such as: angles, adhesive tapes, plastic films, among others.

- **Convergent packaging systems:** The supply of each component or input for packaging and product manufacturing is delivered in packaging and incorporated into the production process. These items become the responsibility of the company, which needs to define their disposal. Therefore, the framework highlights that there are these items that come from outside the process and are discarded within the company, to help decide with input suppliers how to reduce or eliminate packaging or improve their recycling value.

- **Waste generated:** During the filling and distribution process, a lot of waste ends up being generated, such as: empty packaging, adhesive tapes, plastic films, adhesive liners, tubes, pallets, packaging damaged in machine setup, excess product protection, inadequate storage, among others. It is important to identify them to act promptly in each situation, proposing improvements and reductions.


**Figure 5:** Schematic representation of the PS framework.
**Source:** by the authors.

In this representation, all stages of this process generate packaging waste, whether due to the disposal of input packaging, or losses in the process (losses due to machine adjustments, handling failures, breakdowns, etc.). Furthermore, at almost every stage there is a convergence of the SP of the inputs, which become waste under the responsibility of the company that is using these inputs. Observing PS in companies, one can see how natural it is for employees to use these packaging and subsequently discard them to the recycling sector. Therefore, the representation shows that these come from outside the process, and are discarded within the cycle, within the company. Likewise, the use of accessories, such as adhesive tapes, lamination (stretch film), corners, among others, also became more evident.

The sales channels where the product will be sold, as well as the use of the product by the consumer, also influence the product design and packaging requirements, which end up impacting the processes. It is important to highlight that at the sales stage it was observed that, in addition to the disposal of tertiary and higher level packaging, there is also the addition of new packaging in the cycle, such as bags for the customer to transport the product from the store to their home, or boxes of transport to send products via e-commerce, for example, generating yet another packaging disposal. Furthermore, in the product use stage, all packaging that reaches the consumer is discarded, this being the most criticized point in terms of sustainability as it is the most visible to consumers, who are responsible for separating waste and disposing of it appropriately. to collection points for recycling. Finally, the framework highlights suppliers of packaging and inputs, which are essential in the cycle.

The elements contained in this graphic representation help to understand the possible waste and environmental impacts caused during the product manufacturing and distribution process. The companies Packaging System is unstable and is in constant movement, as new analysis and mapping needs may arise in each application situation. The proposal presented the main points to be observed during this process. The following presents the application of the framework during the study carried out by the project team.



### 4.1 Artifact validation

The framework was tested in a dairy company in the state of Goiás through a study carried out in March, April, and May 2023. The main objective was to map the company's Packaging System, aiming to reduce costs and environmental impact. In the first stage, an immersion in production was carried out to follow the processes from the entry of raw materials to the finished product upon dispatch. Through observation and interviews with managers from the areas in which the packaging participates (internal stakeholders), an infographic was developed containing all the packaging and components used in each production line. Based on the structure proposed in figure 4, the PS was analyzed following the same order. The analysis resulted in the graphic representation presented in figure 6, developed from a production line from this company, responsible for packaging culinary bases for other food industries (B2B).

**Packaging and product life cycle:** The product is manufactured by mixing ingredients in aluminum tanks in the UHT (Ultra High Temperature) process and sent

to the filling equipment via piping. The machine fills the product by automatically opening and closing the packaging, which, using a conveyor belt, is directed to packaging in shipping boxes, for subsequent stacking on pallets. The complete pallet is sent to another sector that adds angles, identification labels for the carrier and stretch film. After this process, the product is collected on the same day it was produced and sent to the customer via third-party carrier.

**Classification of packaging:** The production line analyzed uses multilayer bags as primary packaging, with identification on an adhesive label; the secondary ones are cardboard boxes for stacking and transporting the bags (2 bags of 10L or 4 bags of 5L per box); At the tertiary level, palletization takes place, using adhesive tape, angle irons, plastic sheets, stretch film and a cardboard base between the product and the pallet.

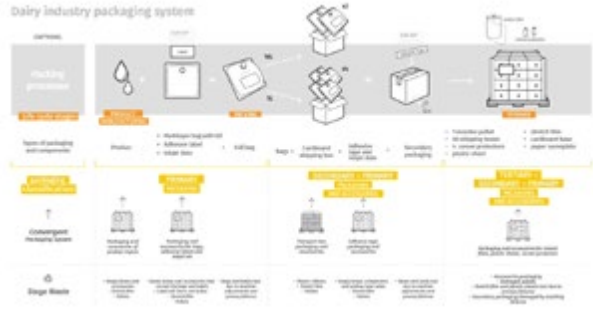


**Figure 6:** Design of the Packaging System for a dairy industry.
**Source:** by the authors.

**Internal and external processes:** In the scenario of the analyzed company, the internal sectors involved with this production line are purchasing, shipping, production, R&D, warehouse, SAC, and quality. The external processes observed were filling system supplier (responsible for equipment and packaging supply), transport companies and input suppliers.

**Convergent packaging systems:** All packaging from product manufacturing input suppliers were mapped. An accumulation of empty packaging, pallets, components, and accessories used to contain and transport inputs was noticed. A meeting with suppliers was suggested to propose a complementary study for their PS, with the aim of evaluating the reduction in the amount of packaging and the use of raw materials with greater recycling value.

**Waste generated:** The waste generated during the manufacturing process was, for the most part, empty boxes, adhesive liners and stretch film coming from various input suppliers. In this case, the loss of primary packaging during machine setup is practically zero, as the filling system does not waste packaging during setup or product change. Some cardboard boxes and bags were lost due to damage during palletizing and internal movement of the finished product.

The solutions for reducing waste and environmental impact in the analyzed production line were presented and validated with the company's management, they are: the increase of 1 liter of product per bag, since the internal free space (headspace) was greater than as necessary, without compromising the performance of the product and packaging in its chain, and providing a 20% reduction in packaging used to contain the same volume of product monthly; reduction in the size of the identification label; resizing of shipping boxes; replacing paper angles with molded pulp (made by reusing scraps) and reducing the number of layers of stretch film to protect the stacking of palletized products.

## 5. FINAL CONSIDERATIONS

The present study was designed based on the theoretical-practical experiences of the authors, through an in-depth study of the literature and consultancy work on Packaging Systems in industries, using and improving the proposed framework. Answering the research question: how to identify losses related to packaging in the production system with the aim of identifying opportunities for improvement and reduction of environmental impact? The proposed framework contributed to making visible the totality of packaging and components within the system, as well as the converging systems of input suppliers, the step-by-step process of each stage of the life cycle and the waste generated during each stage in the integration between packaging and the product.

It is understood that this study encourages a systemic view of packaging processes, being an initial tool for analyzing waste that may be occurring within product manufacturing companies and/or packaging companies. Other support tools, metrics and indicators for evaluating the improvements implemented, sectors and stakeholders to be analyzed throughout the study must be customized according to the types of products, processes and company context. This is because we sought to develop the framework so that it was applicable to companies from different segments and regardless of their specific characteristics.

Packaging should be analyzed as key elements in production and logistics processes, as they accompany the product from the point of packaging to the point of consumption. Throughout the study, it was possible to observe that, in addition to better organization of processes and cost reduction, the identification of waste of resources that emerge throughout the PS mapping can guide the company to the incessant search for incremental and continuous improvements in processes. organizations in a systematic and constant way, allowing to achieve increasingly higher levels of efficiency and quality. For example, in the dairy industry it was possible to identify an opportunity to reduce packaging used to contain the same volume of product by 20%, if the improvements proposed from the study were applied.

Proposed changes can range from the physical reorganization of workstations to the implementation of new technologies to speed up the packaging process. Monitoring and measuring the impact of these changes through key performance indicators allows for an objective assessment of the results achieved. Furthermore, engaging the entire packaging team in this evaluation process makes it possible to collect valuable insights from those directly involved in the workflow. Recognizing individual contributions and encouraging the presentation of improvement ideas creates an environment conducive to innovation and evolution of packaging processes. Expanding the possibilities of actions to reduce environmental impact, it is recommended to rethink packaging projects at one or more levels (primary, secondary, tertiary, etc.); change packaging and handling processes for goods; evaluate the exchange of materials, production processes and packaging suppliers; readjust distribution and logistics systems; eliminate packaging components and properly dispose of pre-consumption waste. Understanding that packaging is part of a life cycle and that there are many elements involved to be considered is the way to promote sustainability in packaging.

Therefore, this study reinforces the fact that investing in the organization and effective mapping of Packaging Systems represents not only an operational strategy, but also a commitment to the sustainability and global effectiveness of industrial practices. Finally, it is recommended as future studies the integration of other support tools, coming from different areas of knowledge, such as: Lean manufacturing, Product-Service System (PSS), the principles of the circular economy, the analysis of the packaging system and from economic and social perspectives, among others.

## REFERENCES

ABDUL KHALIL, H. P. S. et al. A review on nanocellulosic fibres as new material for sustainable packaging: Process and applications. **Renewable and Sustainable Energy Reviews**, v. 64, p. 823–836, 2016.

ASSOCIAÇÃO BRASILEIRA DE EMBALAGEM. ABRE. **Embalagem e sustentabilidade: desafios e orientações no contexto da economia circular.** 1ed. SãoPaulo: CETESB, 2016.

BARABASI, A.-L. The architecture of complexity. p. 3–3, 2005.

BESIER, S. Generational perceptions of pro-environmental packaging advantages. **uwf UmweltWirtschaftsForum,** v. 23, n. 4, p. 315–322, 2015.

BRISSON, I. Packaging waste and the environment: economics and policy. **Resources, Conservation and Recycling,** v. 8, n. 3–4, p. 183–292, 1993.

BUCCI, D. Z.; FORCELLINI, F. A. Sustainable packaging design model. Complex Systems Concurrent Engineering: Collaboration, T**echnology Innovation and Sustainability**, v. 55, n. 47, p. 363–370, 2007.

A. C. CABRAL;, & D.B. CABRAL. (2021). Gerenciamento sistêmico de embalagem em indústrias fabricantes de bens de consumo. XXX ENEGEP, 2010.

CARVALHO, M. A. Engenharia de embalagens: uma abordagem técnica do desenvolvimento de projetos de embalagem. 1. ed. São Paulo: Novatec, 2008.

CASAREJOS, F. et al. Rethinking packaging production and consumption vis-à-vis circular economy: A case study of compostable cassava starch-based material. **Journal of Cleaner Production,** v. 201, p. 1019–1028, 2018.

DE KOEIJER, B.; DE LANGE, J.; WEVER, R. Desired, perceived, and achieved sustainability: Trade-offs in strategic and operational packaging development. **Sustainability (Switzerland)**, v. 9, n. 10, p. 1923, 2017.

DRESCH, A.; LACERDA, D. P.; JUNIOR, J. A. V. A. Design Science Research. 1. ed. Porto Alegre: [s.n.], 2015.

DRESCH, A.; PACHECO LACERDA, D.; CAUCHICK-MIGUEL, P. A. Design science in operations management: conceptual foundations and literature analysis. **Brazilian Journal of Operations & Production Management**, v. 16, n. 2, p. 333–346, 2019.

HELLSTRÖM, D.; NILSSON, F. Logistics-driven packaging innovation: A case study at IKEA. **International Journal of Retail & Distribution Management**, v. 39, n. 9, p. 638–657, 2011.

JANG, Y. C. et al. Recycling and management practices of plastic packaging waste towards a circular economy in South Korea. **Resources, Conservation and Recycling**, v. 158, n. February, 2020.

MAHMOUDI, M.; PARVIZIOMRAN, I. Reusable packaging in supply chains: A review of environmental and economic impacts, logistics system designs, and operations managementInternational J**ournal of Production EconomicsElsevier** B.V. 2020a.

MOLINA-BESCH, K., & PALSSON, H. Packaging for eco-efficient supply chains: Why logistics should get involved in the packaging development process. **Transport and Sustainability**, 6, 137–163. (2014). https://doi.org/10.1108/S2044-994120140000006006

MOURA & BANZATO. Embalagem, unitização e conteinerização. 2. ed. São Paulo: IMAM, 1997.

MUNIZ, E. C. L.; POSSAMAI, O. Complexidade de novos produtos: um modelo dinâmico para análise da perda de produtividade em sistemas produtivos. **Gestão & Produção**, v. 26, n. 1, 2019.

PALSSON, H., FINNSGARD, C., & WANSTROM, C. Selection of packaging systems in supply chains from a sustainability perspective: The case of volvo. **Packaging Technology and Science**, 26(5), 289–310. (2013). https://doi.org/10.1002/pts.1979

PETLJAK, K.; NALETINA, D.; BILOGREVIĆ, K. Considering ecologically sustainable packaging during decision--making while buying food products. **Ekonomika poljoprivrede**, v. 66, n. 1, p. 107–126, 2019.

ROBERTSON, K., GARNHAM, M., & SYMES, W. Life cycle carbon footprint of the packaging and transport of New Zealand kiwifruit. **International Journal of Life Cycle Assessment**, 19 (10), 1693–1704, 2014. https://doi.org/10.1007/s11367-014-0775-5

SASTRE, R., DE PAULA, I. C., ECHEVESTE, M. E. S., & ZENI, C. F. Radar da embalagem: uma referência preliminar para o projeto de embalagem em um contexto sistêmico e de complexidade. 12o Congresso Brasileiro de Inovação e Gestão de Desenvolvimento Do Produto, 1–16, 2019.

SASTRE, R. M.; DE PAULA, I. C.; ECHEVESTE, M. E. S. A Systematic Literature Review on Packaging Sustainability: Contents, Opportunities, and Guidelines. **Sustainability**, v. 14, n. 11, p. 6727, 2022.

SELVIARIDIS, K.; MATOPOULOS, A.; SZAMOSI, L.; PSYCHOGIOS, A. Reverse resource exchanges in service supply chains: the case of returnable transport packaging. **An International Journal**, v. 21, n. 3, p. 1–25, 2016.

SHINGO, Shigeo. A study of the Toyota Production System from an industrial engineering viewpoint. Cambridge, MA: Productivity Press, 1989.

SZCZEPAŃSKA, N.; KUDŁAK, B.; NAMIEŚNIK, J. Recent advances in assessing xenobiotics migrating from packaging material – A review. **Analytica Chimica Acta**, v. 1023, p. 1–21, 2018.

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# CULTURE, HISTORY, NATURAL MATERIALS IN ANGOLA: VERNACULAR ARCHITECTURE AND THE POSSIBILITIES FOR MORE SUSTAINABLE CONSTRUCTION

## *CULTURA, HISTÓRIA, MATERIAIS NATURAIS EM ANGOLA: ARQUITETURA VERNACULAR E AS POSSIBILIDADES PARA UMA CONSTRUÇÃO MAIS SUSTENTÁVEL*

## *CULTURA, HISTORIA, MATERIALES NATURALES EN ANGOLA: ARQUITECTURA VERNÁCULA Y LAS POSIBILIDADES PARA UNA CONSTRUCCIÓN MÁS SOSTENIBLE*

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**ABSTRACT**
This article focuses on the Angolan vernacular architecture and is part of a master's dissertation. As a cultural heritage, understanding vernacular architecture also helps us search for more sustainable construction alternatives. To this end, this article aims to characterize the Angolan vernacular architecture by carrying out a theoretical literature review and a case study in the province of Huíla (Mupalala), Angola, for the cubatas of the Nyaneka-Humbi ethnic group. For this case study, it was imperative to interview local residents in order to understand the cultural aspects of construction, building techniques and materials used. In the end, it was possible to characterize this type of construction and understand possible contributions to propose more sustainable construction.

**KEYWORDS**
Vernacular architecture; Sustainability; Natural materials; Construction techniques; Angola.

***RESUMO***
*Este artigo tem como foco a arquitetura vernácula Angolana e faz parte de uma dissertação de mestrado. Enquanto uma herança e patrimônio cultural, compreender a arquitetura vernácula nos auxilia também na busca por alternativas de construção mais sustentáveis. Dessa forma, esse artigo buscou caracterizar a arquitetura vernácula Angolana para o que foram realizados uma revisão bibliográfica teórica e um estudo de caso na província de Huíla (localidade de Mupalala), Angola, para as cubatas da etnia Nyaneka-Humbi. Para o estudo de caso foi necessário entrevistar os moradores locais de forma a entender os aspectos culturais da construção, técnicas construtivas e materiais empregados. Por fim, foi possível caracterizar esse tipo de construção e entender eventuais contribuições para a proposição de uma construção mais sustentável.*

***PALAVRAS-CHAVE***
*Arquitetura vernácula; Sustentabilidade; Materiais naturais; Técnicas construtivas; Angola.*

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## *RESUMEN*

*Este artículo se centra en la arquitectura vernácula angoleña y forma parte de una disertación de maestría. Como herencia y patrimonio cultural, comprender la arquitectura vernácula también nos ayuda en la búsqueda de alternativas de construcción más sostenibles. De esta manera, este artículo buscó caracterizar la arquitectura vernácula angoleña mediante una revisión bibliográfica teórica y un estudio de caso en la provincia de Huíla (localidad de Mupalala), Angola, para las cabañas de la etnia Nyaneka-Humbi. Para el estudio de caso, fue necesario entrevistar a los residentes locales para comprender los aspectos culturales de la construcción, las técnicas constructivas y los materiales empleados. Finalmente, fue posible caracterizar este tipo de construcción y entender posibles contribuciones para la proposición de una construcción más sostenible.*

## *PALABRAS CLAVE*

*Arquitectura vernácula; Sostenibilidad; Materiales naturales; Técnicas constructivas; Angola.*

## 1. INTRODUCTION

This article is part of a master's research project aimed at discovering solutions for more sustainable construction in Angola, based on the principles of the country's historical construction. The research presents Angola's vernacular construction, identifying its characteristics in terms of materials and construction techniques, as well as the local cultural aspects that led to the development of the arrangements and propagation of the construction system. This article focuses on the traditional vernacular architecture heritage that manifests the essence and origin of construction in Angola that is seen as promise for more sustainable construction in the country.

**Figure 1:** Vernacular architecture in southern Angola, also known as traditional construction *Nyaneka Humbi, (Mupalala- Quipungo-Huíla)*.
**Source:** Autor.

Figure 1 shows the vernacular construction found in southern Angola. In this case, the building was made of wood available on site, and covered by grass, in the style of pau a pique. There is a difference in the diameters of the trunks in the ceiling elements of those that make up the system of frames and thresholds of the main access door, whose leaf appears to be made of wood (pau-ferro). Also noteworthy is the absence of foundation elements and the contact of the natural material with the ground, which can cause rapid degradation of the structure.

Most of the records of traditional vernacular buildings are found in the southwest (Huíla, Cunene) and north (Uíge and Zaire) of Angola, especially in rural areas, because they cost less to build and the materials are readily available. In general, these constructions, are generally built by the owners of the house (they were self-built) and belong to people who are still very conservative and seek to preserve their cultural traits.

The reason for studying this topic is that in Angola, and particularly in the province of Huíla, there is a high level of poverty among families, making them vulnerable and with limited access to public housing policies due to the high cost of construction. In this context, vernacular buildings appear to be part of the solution, as they are built by local people whose construction techniques are influenced by their geography, climate, traditions, cultures and materials (MISRA, 2016). However, if these buildings were analyzed through the lens of contemporary construction techniques, they could be innovated and improved in order to make them even more sustainable or to lend their characteristics to contemporary construction.

The local population in these regions of Angola have special knowledge of regional characteristics and has developed these techniques through long-term experience (ANNA-MARIA 2009; ZHAI and PREVITALI, 2010).

In Huíla, Angola resorts have been constructed on farms and tourist areas, blending traditionalism and modernism through innovative techniques, however this fusion is not evident when it comes to residential houses, which would be interesting because these innovative practices have an impact on reducing the cost and durability of houses and making them more functional because the owner is directly involved in the construction process. Also because vernacular architecture is directly linked to sustainability. However, vernacular architecture is not employed in Angola as it does not form a component of the urban planning repertoire. It is therefore out of step with the pace of social and technological development. It is essential to save construction techniques, along with revising of procedures to enhance longevity, in conjunction with the possibilities of community participation, seeking to preserve traditions with a minimum of de-characterization.

Librelotto and others (2022) argue that man's building tradition is intrinsically connected to the surrounding environment. For thousands of years, man has used the resources available to him to live. He began with caves and the construction of portable housing, until he became sedentary and used local available materials to build. Earth, stones, fibers, branches and leaves were the most commonly used materials. The techniques of building with earth, for example - including pau a pique, which will be observed in this research - spread globally and examples can be seen in various parts of the world.

This article provides an overview of the construction techniques employed in the village of Mupalala, Huíla,

which is 25 kilometers from the town of Quipungo, in the province of Huíla in Angola, as it strongly preserves vernacular practices in its construction process. The experience of some local and grassroots technicians, familiar with the process, facilitates the search for solutions that can be replicated in other parts of the country, with some modifications and suggestions in order to take advantage of its principles and promote greater longevity. Another reason is the fact that most of the inhabitants of the regions are low-income (poor), making them the target audience of this study in the development of technical conservative and innovative housing solutions based on vernacular architecture and its relationship with sustainability.

## 2. METHODOLOGICAL PROCEDURES

The methodology used is aimed at answering the research question and consequently fulfilling the general objective: can Angolan vernacular architecture enable more sustainable construction in Angola? This article seeks to answer the question of how the Angolan vernacular architecture is characterized.



In order to achieve this goal, it was applied the literature revising method, identifying the most relevant national and international titles were identified from among the available scientific studies. The revising was followed by a descriptive analysis of a case study of a detached single-family house in the province of Huíla. As a methodological strategy, the following keywords were defined to facilitate the literature search: Vernacular architecture. Sustainability. Sustainable innovations. Buildings. Sustainable houses or dwellings.

The characterization of vernacular architecture in Angola has been done in a theoretical way, taking into account some researchers who have carried out studies on the subject, it is worth mentioning some names such as: Redinha (1973), Daniel (2019) and Dias and Palhares (2015; 2013). In this characterization, fundamental aspects have been presented, such as the formal and design similarities and differences between regions of the country, taking into account cultural, geographical and climatic aspects, as well as the main materials. From a more technical and practical point of view, the project analysis took into account the aspects that define or characterize sustainable construction, such as: the construction system used in the project, its materials and origin, community participation and continuity, costs and policies for participation and housing acquisition, energy efficiency, thermal and lighting comfort.

It should be noted that one of the architects who has developed projects oriented to this reality and with a contemporary modern framework is Francisco Benguela, and one of his projects was the foundation for this research. It addresses fundamental issues such as community participation in management throughout the process of design, construction, and post-construction, as well as cost issues and the use of local materials with low environmental impact.

After the theoretical study, a case study was conducted in the Huíla region to understand the construction features, materials and techniques used. Interviews were conducted with the local community, the research was registered with the ethics committee and the interviewees signed a consent form with full disclosure.

## 3. STATE OF ART

### 3.1 From vernacular architecture to sustainability

According to UNESCO, "heritage is the cultural legacy that we have received from the past, that we live in the present and that we will pass on to future generations". Pastor (2003) argues that the knowledge and experience of heritage is important for the affirmation of the community itself and a key factor in the development of a place, both for the economy and for tourism, promoting territorial equilibrium. This practice promotes territorial equilibrium through the cultural offer of heritage protection connected to local sustainability, as it helps to preserve natural resources, enhance the value cultural and natural landscapes in accordance with the well-being of people the transmission of ancestral knowledge and environmental values.

According to the etymological approach confirmed by the Historical Dictionary of the French Language (ROBERT, 1985), vernacular, in architecture, refers to the house of verna, which in Latin means "slave born in the house". Vernaculus means 'native' or 'domestic'. This definition appears in Roman law, in the empire of Theodosius the Great (347-395). Authors such as Illich (2005) and Frey (2010, p. 13) provide a derivation of the term as "vernacular type" meaning

> "Everything that has been worked on, made or created at home and not for sale, but for domestic use. Therefore, what is 'vernacular' has

> no market value. By extension, this definition includes the architecture of a territory and/or of a human group, or ethnic group, that lives there. Vernacular architecture often uses local materials (AA.VV., 1993, p. 4).

Vernacular generally refers to "traditional" or "popular" architecture, as opposed to "academic" architecture. Prompt (2021) describes that "humanity developed building techniques to shelter and protect itself from the weather, and so the specific architecture of each time and place developed, appropriately identified as vernacular architecture. "

Barbacci (2022) explores the concept of vernacular architecture from two prehistoric origins and presents some examples from around the world that represent lessons in sustainability and bioclimatic design. The author introduces Bernard Rudolfsky's concepts that characterize vernacular architecture as architecture without architects: it is asymmetrical and differentiated, as opposed to formal architecture, which is symmetrical and impersonal; it is produced communally and anonymously, with local characteristics; it communicates with its surroundings and is not transferable outside its context; it tends to be durable and its orientation is essential, using the sun and wind to create comfort rather than glass curtains and air conditioning; it coexists harmoniously with animals and, finally, it is a manifestation of the human spirit. The research includes examples ranging from the origins of cave dwellings in Turkey, Cappadocia in the form of underground buildings and cities in the rock, ground dwellings in Tunisia, and bamboo dwellings in Dorze, to more recent constructions such as the cities of Shibam in Yemen, the Ksar in Morocco at Ait-Ben-Haddou, and the Arhuacas villas in Colombia.

The vernacular buildings were designed to maximize the use of local materials. The use of stone, adobe, and wood determined local architectural aspects and employed construction methods that were fully adapted to the environment (PHILOKYPROU et al. 2017; REN 2018). Traditional houses generally refer to time and space in relation to the past, while vernacular houses are less related to time and are more specific to the site.

In general, vernacular architecture is the functional architecture of the local people, which is shaped by the environment, features, climate, local materials, socio-cultural characteristics and traditional technology. It tends to take advantage of local building resources as well as passive and low energy strategies that do not damage the environment but also protect nature (UPADHYAY, YOSHIDA AND RIJAL, 2006; BAŞARAN, 2011; ESIN AND YUKSEK, 2010; SOUSA SANTOS, 2016; SALJOUGHINEJAD AND SHARIF ABAD, 2015).

Vernacular architecture, therefore, is part of human heritage and can be translated as an expression of a community's identity and the value of the natural and traditional environment with which they have produced their own habitat. It is the result of the relationship between man and his environment and directly reflects the ways of inhabiting the territory through knowledge passed down from generation to generation (Gonzalez, 2010).

Today, vernacular architecture is no longer associated with poverty and precariousness as it once was (Barbacci, 2022). For the author, the reassessment of the vernacular brings ethics and sustainability to architecture and becomes potentially promising before threats of climate change, appropriating ecological criteria, systems and technologies integrated with the cultural and natural landscape.

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### 3.2 Characterization of Angolan vernacular architecture

Angola, similar to whole African continent and due to its impressive territorial extension, has a wide variety of climates, natural resources, landscapes, geology and hypsometry/relief. It has landscapes ranging from tropical rainforest in the north to open forest and savannah in the central plateau and desert in the south.

DANIEL (2019) characterized the Angolan architecture in three predominant architectural typologies, in which they are inextricably linked to the social, cultural and economic transformations that the country has undergone, namely throughout the period of its discovery in the 15th century, alongside with the colonization era,

the civil war and the post-war time up to the present. The three main typologies are classified as

> Vernacular architecture: Houses that are more common in rural areas and have few records in peri-urban and urban areas. They are essentially built with pau-a-pique (ironwood) or adobe walls and thatched (grass) roofs.
>
> Colonial architecture: Buildings constructed during the Portuguese administration in all the capitals of the 18 provinces and the seats of the 162 municipalities, with different styles, formal elements and construction techniques.
>
> Contemporary Architecture: Recent constructions with reinforced concrete structural elements, ceramic brick or concrete block walls and tile roofs, in the center or on the outskirts of urban areas. (Our translation, source: DANIEL, 2019,p. 10)

This research was carried out in the southwestern part of Angola, in the province of Huíla, situated in the easternmost part of the country (about 60% of the territory). This region rises in a series of plateaus with altitudes around 1200 and 2100 meters (WHEELER & PÉLISSIER, 2009, p. 25). The highest point in the country is Morro do Moco, situated in the province of Huambo, at an altitude of 2620 meters. Although it is only one topographical zone, given its size and the fact that it represents a large part of the country, it is necessary to present some variations in the shape and architectural features of the houses in each subdivision of this region.



In the northern part of this zone, the roofs are quite high and sloped to facilitate water drainage due to the large and intense rainfall. It is also common to have a veranda around the entire house, with a width varying around 1 and 1.5 m, and at a level of about 20-40 cm above the ground, whose main function is to protect the living space from the infiltration of rainwater (DANIEL , 2019 ).

In the central part of this topographic zone, there is a different configuration, where the roofs hardly exceed the limit of the walls, so that the dwelling is exposed to direct solar radiation, because there is a need to cool the dwelling.

In the southern part of this area, the architectural differences in form and construction process are not necessarily due to climate or relief, but rather to cultural aspects. For this reason, most of the dwellings are made up of open spaces as the main zones for cultural, social and recreational activities, with the dwelling being a mere sleeping space.

> Vernacular architecture includes the oldest dwellings of the territory, known as "cubatas", whose construction techniques have been handed down from generation to generation. It is characterized by the common use of organic (vegetable) materials, which evolved in techniques that became quite effective. Thatched roofs (grass), which replaced banana leaves, reflect this evolution, as they allow greater longevity of the construction and waterproofing (DANIEL,2019, p.10 and 11).

Angola is characterized by a great ethnographic heterogeneity, where each ethnic group or subgroup has specific socio-cultural characteristics that differ from one another. However, when it comes to the features of construction and the materials used, there are few differences, since the most commonly used materials - sticks, reeds, thatch, wood, adobe and stone - are easily found throughout the country, although they have different characteristics. José Redinha, in his book "A habitação tradicional Angolana - aspectos da sua evolução" (Traditional Angolan Housing - Aspects of its Evolution), describes the various traditional housing types according to their geographical distribution, ethnography and construction aspects - materials, structure and methods of construction.

The differences in vernacular typologies in the main regions of Angola are quite marked and motivated by the following factors: socio-economic, cultural and environmental, a fact that translates into variations in form, materials, techniques and construction methods from region to region. Table 1, taken from Daniel (2019), shows the basic types of traditional houses identified in the three regions in a schematic and classificatory approach, in terms of their formal characteristics (plan and elevation). The classification criteria used are also based on aspects such as differences and/or similarities in construction methods and materials used.

Thus, in groups I and II, we find dwellings with ephemeral characteristics, used mainly by nomadic peoples such as the Khoisan and the Hereros. They are easily distinguished by their circular floor plan, with walls and roof forming a single element. In group III, the dwellings have been grouped according to their construction system, while in numbers IV and V, the dwellings are clearly similar in terms of their rectangular floor plan and roofs that are larger than the living space, creating shaded areas and additional protection against heavy rains.

| | | | |
|---|---|---|---|
| Região Sul | Herero | Grupo I: abrigo de terra maciça, estruturalmente construído com varas de madeira |  |
| | Khoisan | Grupo II: Abrigo de capim seco, estruturalmente construído com varas de madeira |  |
| | Ambo e Nhaneca-Humbe | Grupo III: Casas de paredes de troços de madeira verticais, com a cobertura de colmo apoiada nestas |   |
| Região Norte | Ambundo | Grupo IV: Casas de paredes de adobe cujo telhado de colmo, que se apresenta sempre saliente, é suportado por varas de madeira rústica |  |
| | Bacongo | |  |
| | Lunda-Quioco | |  |
| Planalto central | Ganguela | Grupo V: Casa de Pau-a-Pique cujo telhado de colmo, que se apresenta sempre saliente, é suportado por varas de madeira rústica |  |
| | Ovimbundo | Casa de paredes de adobe, com a cobertura de colmo apoiado nestas |  |

**Table 1:** Types of vernacular dwelling.
**Source:** DANIEL (2019) - adapted from Redinha (2009).

Regardless of the differences from region to region, the same traditional constructions can also be identified by their common characteristics. The materials that predominate in Angolan vernacular architecture are those derived from raw earth construction technologies and those of plant origin. Sticks, reeds, thatch (capim), and wood, as well as earth in the form of adobe bricks or pau-a-pique or pau ferro, are traditionally incorporated into building systems.

Stone, being a natural resource with a certain availability and durability, is not sufficiently used in traditional construction (GANDUGLIA M, 2012 and 2013), although it is exceptionally used for the foundations of houses to protect them from the action of water. In general, vernacular houses are small, ranging from 10 to 25 $m^2$ in area, with more or less rooms, with little importance given to collective interior spaces such as living rooms, with the largest area being used for sleeping, since leisure time is usually spent outside the house. The hot climate creates the need for covered outdoor spaces, which are so widely used by rural communities in Angola and called Jango (gazebo). This is one of the fundamental spaces in traditional housing, as if it were our living room. It is a space for leisure and gathering, characterized by its thatched roof (capim), based on an open wooden structure that allows natural ventilation. It has a simple plan that varies from circular to rectangular, depending on the region of Angola (REDINHA, 1973).

In terms of design references directly applied in Angola, we highlight the project "Urbanization of Quissala, evolutionary houses in the municipality of Huambo, Huambo province, Angola", designed by Grongel Calei, Francisco S. Benguela and DW-HabiTerra S.A (2016). The project aims to provide affordable housing solutions through technologies and construction methods that help reduce the overall cost of the contract, as well as the provision of housing credit products for the marketing of these homes. These homes are targeted at students displaced from other parts of the country with low financial power, as well as the middle and lower end of the market in general.

The architectural plans have been created taking into account the principles of sustainability and the roots of vernacular architecture, where much attention has been paid to the following aspects: evolutionary constructions, community participation, possibilities of obtaining housing loans and natural and regional components and materials.

Evolutionary Constructions - the plans were made in phases, where the company only builds phase 1, which includes 1 (one) common room, 1 (one) bedroom and 1 (one) common bathroom, and delimits the total area of implementation with the future services (Figure 2), thus laying the foundation for families to have the possibility to grow according to a previously prepared plan, avoiding additional project costs, avoiding the risk of building without an architectural plan.

Community Participation - A committee of residents has been created to oversee the management and continuity of the project, with residents actively participating in the subsequent phases of construction and expansion of their own homes and social services (schools, hospitals, shopping centers, electrification systems and water supply, among others).

Housing Credit - HabiTerra S. The promoter of the project has created a housing credit line in partnership with the company KIXI-CRÉDITO S.A. to facilitate the purchase of homes by the target population. This means that to have access to credit, the citizen does not necessarily have to be a civil servant or work in the formal market, a requirement that is quite common in other banking institutions and that has made life quite

difficult for citizens, since a significant majority work in the informal market. What KIXI-CRÉDITO S.A. requires is the proof of financial capacity for this act, a constant and credible income, whether formal or informal, and the suitability of the citizen.

Natural materials and regional components - one of the main materials used is BTC and wood, which reduces the environmental impact, the cost of housing is lower, giving greater openness to community participation in the construction process (Figure 3). The foundation and paving elements use stones with a well-compacted base. In the upper part of the basement (foundation), before laying the first block, a strong mortar of 2 to 3 cm is applied, capable of preventing the rise of capillary water that could bring humidity to the walls. The cellar box (foundation) is filled with properly compacted red earth. The walls are built with compressed earth blocks (CEB) and mortar is applied (the same used to make the blocks). The porch column is made of BTC in square or circular shape. Over the doors and windows, lintels made of U-shaped blocks are placed, reinforced with rebar, and concreted. To allow the transition of the evolutionary phases of architecture, blocks are left protruding where blocks from the other phase will fit. The house does not have a draught system.

The ceiling is made of corrugated zinc sheets, supported on a structure of 60x40mm iron pipes, painted with black and primary color. The window frames are made of solid wood slats, except for the bathroom window, which is glazed. The electrical and hydraulic installations follow the standard with the use of plastic as the basic material.



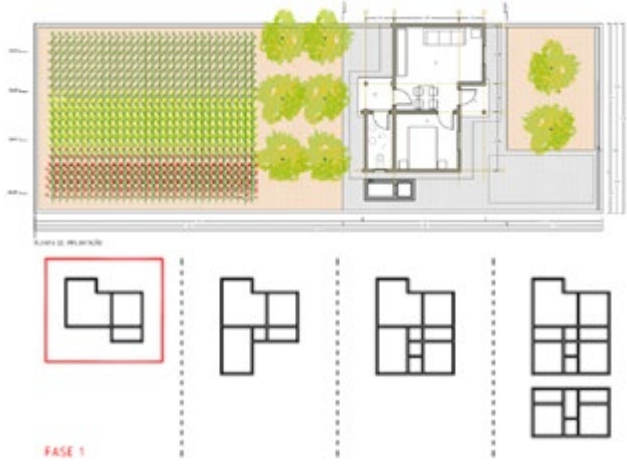


**Figure 2:** Implementation of the T1-type evolutionary residence on the lot and its respective phases.
**Source:** BENGUELA (2014).

**Figure 3:** T1 semi-detached houses.
**Source:** Authors.

### 3.3 Assessment and design methods

For vernacular architecture to serve as a reference for more sustainable architecture, two aspects need to be defined: a form of evaluation that allows defining the parameters and criteria that can underlie the architecture, and a design method that is suitable for the association of vernacular with sustainability.

In this sense, based on the study of Angolan vernacular architecture, Alexandre (2016) proposes a multi-criteria design method in his master's thesis. To achieve this, the author establishes four phases: i) mapping the territory in several areas of local diversity; ii) crossing these maps with local materials versus vernacular construction techniques; iii) selection of materials adapted to the light structure - particularly in terms of connection and compatibility and iv) development of the structure according to the criteria of ease of assembly, transport and adaptation of elements to local raw materials.

The application of these phases proposed by Alexandre (2016) will lead to the optimization of a bioclimatic strategy in the design of the space, where geometry and materials can respond effectively; integration of a flexible multifunctional program with local culture; expandable modular construction using the standardization of industrialized materials integrated with local ecological materials; ease of assembly and transport using local labor; reuse and upgrading of components and materials, and the evaluation of the social efficiency of the space.

4. Characterization of the Study Location

The buildings under study are located in the province of Huíla, municipality of Quipungo, commune of Ombo, in the villages of Mupalala-Centro, Mupalala-Banda, Matuunda and Canomila. They belong to the Nyaneka-Humbi ethnic group, whose mother tongue has the same name as the ethnic group. The main activities are family farming, pastoralism and cattle rearing. Most of them have adopted the Christian religion in the last 40 years, with no record of any other religious belief than the one

mentioned above. And the village of Canonila, where the inhabitants are mostly from the Vayemba ethnic group, the result of a mixture between the Nyaneka-Humbi and the Nganguela, have Nyemba as their mother tongue, and their main activity is agriculture and in some cases pastoralism - cattle raising. Figure 4 shows the location of the buildings.

The buildings show similarities from a construction point of view (shapes, techniques, materials), due to the strong cultural link, the proximity of the construction sites, which implies the use of the same material in most cases. The main differences are found in the function, that is, in the process of organization, distribution and location of the buildings in the general plan of the village or Quimbo (Eumbo), where there is a strong cultural connection in this process, obeying a hierarchical distribution of spaces according to function and the order shown in Figure 5.

The general plan has a circular shape, with three accesses, the main or front access being delimited by logs/sticks with a larger diameter compared to the other accesses.

Next to the main entrance, on the right, is the first building/hut belonging to the second wife. Her implementation in this position is due to the fact that it is the second relationship, which, according to the facts, always comes after the Quimbo (Eumbo) is already inhabited, and she does not perform the function of matriarch of the family of this Quimbo.

Next, the food storage buildings are placed between the first wife's hut and the second wife's hut. The first wife's building (Cubata) is in a strategic position, perpendicular to the main entrance, and even though it is further away from this entrance, it has visual power because it is the hut that attracts the most attention. Because it is in this perpendicular position, it is the building/hut that guides the shape of Quimbo.

On the left side, next to the main entrance, is the otchoto (family bonfire, living room, common room or meeting room), which is the noble space of Quimbo, because it is where the transmission of knowledge about the culture (origins, habits and customs) and learning the principles that guide the family, how to protect and care for it. It is also the place where the round table is held, around the campfire, to share and relax after a long day of work in the fields and pastures. The otchoto is mainly attended by men, with women rarely taking an active part.

Next to the otchoto, outside the radius that defines Quimbo, is the corral (otchunda), considered one of the most important places because it is the place where cattle are kept. Cattle are the main and most valuable source of income for the family. The corral has a strong connection with the otchoto, since the caretakers of the corral are men.


**Figure 4:** General presentation, location.
**Source:** Authors.

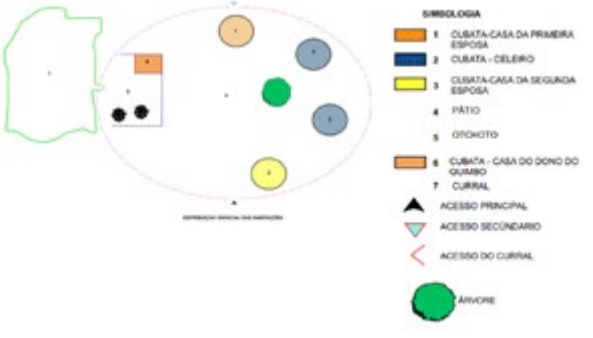


**Figure 5:** Spatial distribution of a village.
**Source:** Authors.

## 5. RESULT: TYPOLOGY AND CHARACTERISTICS OF VERNACULAR CONSTRUCTION

### 5.1 Construction process

The construction process of buildings (Huts), concerning practices, techniques, materials and the architectural form of the building/hut, are also linked to cultural aspects. Most hut models in these areas are circular in shape with a diameter of approximately 6 meters. With the 4 (four) main areas inside described in figure 6.

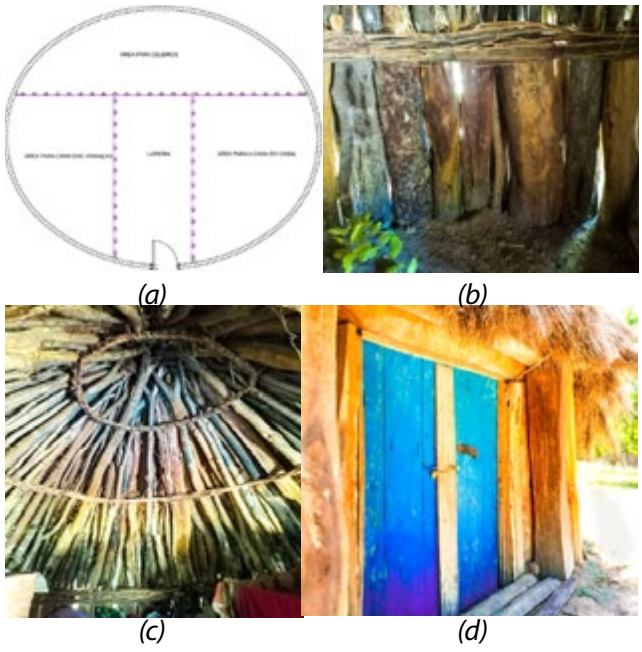


**Figure 6:** (a) Plan of a cubataa; (b) Walls made of rigid logs driven directly into the ground; (c) View of the top of the roof with intertwining of branches in the form of forks and their ties in wooden ribbons. (d), Door jamb in rigid faux wood trunk.
**Source:** Authors.

To build a cubata, they start by marking the foundation (tchico), using a rope as a guide, placing it in the center and making a 360° turn to determine the shape and diameter of the hut. The excavation is as thick as the logs that will be used, with a thickness that varies between 20 and 25 cm and a depth of about 30 cm, which is connected to the wall structure.

In the case of wattle and daub cubatas, the log has the double function of being an element of the foundation and also an element of the fencing system (wall). After digging the trench, there is no treatment of the ground to receive the stick trunks, which are simply aligned and placed on the ground.

The walls (*otchijine*) for the *Nyaneka-Humbi* culture are smaller than the roof and are made of wattle and daub. Care is taken in the selection of the logs used to build the walls. The following types of wood are commonly used: *Opako, Omu Kalati, Omungai and Mutontola*. In Portuguese they are called pau-ferro.

After the walls have been placed, leveled and adjusted, the hut is tied up with what is called a lashing strap. Lashing ropes called *olumbala luotchifini* are attached to the strap. *Onongoi* are taken from trees with specific characteristics for this purpose, such as *omuichi and omumpada*, which are of the same species.

In the roof (*okuyambela*) two phases can be considered: the first is the execution of the structure and the second includes the placement of the grass (elephant grass).

The execution of the structure follows a very interesting order, as if there were a structural project guiding the process:

- first, the woods are placed, properly aligned. These are the main structural frames that will support and hold the weight and the structure of the roof. According to villager Caluvi Muholo (2022), these sticks (Ononguji-Vilua) are placed in a 'fighting position'. (This position is understood as the touching of the pointed areas (with fork shapes) of the sticks, which are fixed to each other, until they are in a position of balance and stability. The villagers call this process ononguci vilua (fighting bulls).

Next, the trunks are placed to help the first 6. These do not have a specific number, but are also from the same family as the ironwood. They are placed in a different/opposite position to the first 6 sticks, from bottom to top, i.e. their pointed area (fork) is supported by the two wall straps and has a flattened, semi-rectangular shape, omavulo.

After this stage, other trunks and branches are placed, which are less demanding in terms of structural requirements, but must meet the straightness requirements, be aligned and be of good quality to secure and reinforce the structure. 3 lashing straps with characteristics similar to those on the wall are also placed.

The ridge on the inside of the roof structure is called Okatongolila, while the middle of the ridge on the outside is called Okalilassangi. The grass used to cover the hut is selected for its good quality and is commonly called Elefante grass (which requires a lot of experience).

The frame openings (windows and doors) have an interesting peculiarity where the stick materials placed in the opening have a cultural meaning. The sticks used

as lintels and thresholds are called Otchipamba and Gando, which means protector (element that protects the entrance and exit of the house).

The logs placed in the opening structures are called *Ekungie otchikuil*.

The logs placed in the opening structures are called Ekungie otchikuilo, which means securer or accessor (securing the door and thus the inhabitants of the house).

It can be seen in Figure 6 (d) that there is a double structure, one in the plane of the opening, consisting of a lintel and a threshold - side posts) of solid fake wood, and another structural framed structure, standing out of the plane, consisting of a beam and side posts, also of fake wood.

The threshold, the lower level of the door, is made of wooden planks to pave the entrance (they look curved to me, resulting from the external unfolding of the trunks).

As for the construction process, it is clear that it is always community-based. Everyone participates in the construction of a hut, with the men working directly on the construction (cutting trees, digging, cutting grass, transporting and cleaning), while the women cook the food and carry water. Typically, the villager with the most experience takes the lead. According to villager Kaluvi, Muholo Pequenino (2023) and the others are support staff or assistants.

The head coach is never paid, even though it is not his own home. In other words, in this tribe, no one makes a living from construction because the activity is unpaid and involves collective work. There is a self-help effort to build houses.

There is no direct transmission of the practical ways of building huts, learning is done through curiosity or practice by participating in the construction. The most interested person learns, the maxim is learning by doing. In some cases, certain teachings are transmitted in the Otchoto (concentration fire).

## 6. CONCLUSIONS

Throughout this bibliographical research, it has been possible to verify that the authors share the same line of thought in terms of concepts, defending that vernacular architecture is directly connected to our roots and ancestry, to the use of materials and specialized local labor, which facilitates execution and consequently cost reduction. As for the case studied in Angola, it is clear that the sustainability aspects associated with the type of construction studied involve the use of natural materials (earth/soil, logs/trunks, wood and grass), at the low level of technology used (without the use of toxic chemical elements or energy incorporated in essentially artisanal materials and construction techniques). In Angola, it was found that vernacular architecture is also linked to the use of local materials and customary practices.

The building tradition is transmitted verbally and empirically where the community is involved in the construction. Community participation is a determinant of the construction process, both in the case under study and in the project references found, where architecture and construction are participatory and evolutionary in terms of adapting to the family life cycle.

However, it was not possible to identify an evolutionary trend and framework that takes into account the constructive culture of the original people in the new urban plans, due to the lack of architectural certification for this type of construction. In the bibliographic search, the keywords helped to find articles in journals that present studies similar to this one, and the methodological strategy of guiding questions also proved to be very effective, since through these questions the theoretical framework and the study design were defined, which in a way led to the achievement of the objective of this research.

Finally, it is clear that cultural aspects are what define the form and layout of houses full of signs, with room for technical improvements in construction without distorting the architecture to increase the durability of the building. There is still room to include aspects related to water, energy and constructive rationalization management.



## REFERENCES

AA.VV. 1993, Vernacular Architecture: ICOMOS International Committee on Vernacular Architecture, International Scientific Committee, 10th General Assembly, Central Cultural Fund, Sri Lanka.

ALEXANDRE, L. Luanda, da arquitetura vernácula ao Séc. XXI. 2016. Dissertação de Mestrado em Arquitetura. Universidade Lusófona de Humanidades e Tecnologias: Departamento de Arquitetura. Disponível em: < https://core.ac.uk/download/pdf/84897822.pdf>

ANNA-MARIA, Vissilia. Evaluation of a sustainable Greek vernacular settlement and its landscape: Architectural typology and building physics. **Building and Environment**, v. 44, n. 6, p. 1095-1106, 2009.

BAPTISTA, Júlio L.; RIBEIRO, Jorge T. Tecnologia vernacular vs. tecnologia global: desenvolvimento de uma metodologia de projeto. **Vernacular Technology vs. Global Technology: Development of a Project Methodology. Lisboa, LNEC: Laboratório Nacional de Engenharia Civil**, p. 322, 2013.

BARBACCI, Norma. Arquitectura Vernácula: concepto, ejemplos y revaloración. **Revista Científica De Arquitectura Y Urbanismo**, v. 43, n. 2, p. 65-71, 2022. Disponível em: < https://rau.cujae.edu.cu/index.php/revistaau/article/download/685/636>

BAŞARAN, Tahsin. Thermal analysis of the domed vernacular houses of Harran, Turkey. Indoor and Built Environment, v. 20, n. 5, p. 543-554, 201.

BENGUELA. Residência evolutiva do tipo T1 e as suas respectivas fases. Documentação do projeto. 2014.

CALEI, Grongel; BENGUELA, Francisco. **Urbanização da Quissala, casas evolutivas no município do Huambo**, província do Huambo, Angola. DW HabiTerra S. A. 2016.

DANIEL,Alberto Fuma Jivala, **Arquitetura Tradicional em Angola- Estratégias de Sustentabilidade**. Instituto Técnico de Lisboa; 2019.misra Disponível em: <https://arqpar.pt» arquitectura_sustetável_angola.> . Acesso em: Novembro de 2021.

DIAS, Domingos; COSTA, Cecília; PALHARES, Pedro. Sobre as casas tradicionais de pau-a-pique do grupo étnico Nyaneka-nkhumbi do Sudoeste de Angola. **Revista Latinoamericana de Etnomatemática Perspectivas Socioculturales de la Educación Matemática**, v. 8, n. 1, p. 10-28, 2015. E-ISSN: 2011-5474

DIAS, D., Costa, C., & PALHARES, P. **Ethnomathematics of the southwestern Angola Nyaneka-nkhumbi ethnic group and its application to mathematics education**. Comunicação apresentada na Internacional Conference of Commission for the Study and Improvement of Mathematics Teaching - CIEAEM, Turim, Itália. 2013.

ESIN, T.; YÜKSEK, İzzet. Ecological analysis of building elements of traditional buildings in the rural area of Thrace region (Turkey). **Journal of Environmental Protection and Ecology**, 2010.

FREY, Pierre. Learning from vernacular: towards a new vernacular architecture. Actes sud, 2010.

GANDUGLIA, M.. **Arquitectura de Terra em Angola**. 2013. Acesso: de Novembro de 2018. Disponível em: <http://arquitecturadeterraemangola.blogspot.com/2013/03/apresentacao-do-livroarquitectura-de.htm>.

Illich, I. 2005, 'Le Genre vernaculaire' in CEuvres complètes, Vol. 2, Fayard, Paris.
GANDUGLIA, M.. **Arquitectura de Terra no Moxico: Do projecto à Construção**. Luanda: EAL - Edições de Angola. 2012.

Librelotto, L., Ferroli, P., Bártolo, H., & Vasconcelos, C. (2022). CONSTRUÇÃO COM TERRA: PASSADO E FUTURO. IMPACT Projects, 1(2), 27-48. https://doi.org/10.59279/impact.v1i2.2077. Disponível em: < https://periodicos.unifesspa.edu.br/index.php/impactprojects/article/view/2077>

MISRA, Manjusha. South Asian vernacular architecture. **International Journal of Environmental Studies**, v. 73, n. 4, p. 481-483, 2016. Disponível em: < MISRA, Manjusha. South Asian vernacular architecture. International Journal of Environmental Studies, v. 73, n. 4, p. 481-483, 2016.>

PHILOKYPROU, Maria et al. Environmentally responsive design in Eastern Mediterranean. The case of vernacular architecture in the coastal, lowland and mountainous regions of Cyprus. Building and Environment, v. 111, p. 91-109, 2017.

PROMPT, Cecília Heidrich.. **Avaliação da sustentabilidade da arquitetura e construção com terra: estudo de caso no oeste catarinense**. Tese de Doutorado. PósARq/ UFSC. 2021.

REDINHA, J. A Habitação tradicional Angolana: Aspestos da sua Evolução (2ª ed.). Luanda: Fundo de Turismo e Publicidade. 1973. Disponível em: < https://fenix.tecnico.ulisboa.pt/cursos/ma/dissertacao/565303595502655>

TILLERÍA GONZÁLEZ, Jocelyn. La arquitectura sin arquitectos, algunas reflexiones sobre arquitectura vernácula. **Revista Aus**, v. 8, p. 12-15, 2010. Disponível em: < https://www.redalyc.org/articulo.oa?id=281722857004>.

UPADHYAY, Anir Kumar; YOSHIDA, Harunori; RIJAL, Hom Bahadur. Climate responsive building design in the Kathmandu Valley. Journal of Asian Architecture and Building Engineering, v. 5, n. 1, p. 169-176, 2006.

UNESCO. Educação Patrimonial. Disponível em: < https://cvunesco.org/educacao/educacao-patrimonial>. Acesso: maio de 2024.

ZHAI, Zhiqiang John; PREVITALI, Jonathan M. Ancient vernacular architecture: characteristics categorization and energy performance evaluation. **Energy and buildings**, v. 42, n. 3, p. 357-365, 2010.

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